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Surface Combustion.

[From the First Howard Lecture by PROF. W. A. BONE, delivered before the Royal Society of Arts, London.]

During his researches upon flame, Sir Humphry Davy discovered, in 1817, that combustible gases will combine slowly with oxygen at temperatures below the actual ignition point. Thus he wrote: "I made various experiments on explosives, by passing mixtures of hydrogen and oxygen through heated tubes. In the beginning of one of these trials, in which the heat was much below redness, steam appeared to be formed without any combustion. This led me to expose mixtures of oxygen and hydrogen in tubes, in which they were confined by fluid fusible metal, to heat; and I found that, by carefully applying heat between the boiling point of mercury, which is not sufficient, and a heat approaching the greatest heat that can be given without making glass luminous in darkness, the combination was effected without any violence and without any light." This led him to try whether temperature of these slow combinations being lower than required to produce flame, might yet be high enough to make solid bodies incandescent. Or, to put the question differently, whether, seeing that the temperatures of flames far exceed those at which solids become incandescent, a metallic wire can be maintained at incandescence by the combustion of gases at its surface without actual flame. He thereupon tried the effect of introducing a warm platinum wire into a jar containing a mixture of coal-gas and air rendered non explosive by an excess of the combustible constituents. The wire immediately became red-hot, and continued so until nearly all of the oxygen disappeared.

He effected similar results with mixtures of air and various single combustible gases (ethylene, carbonic oxide, and hydrogen), all of which were found capable of making a warm platinum wire glow, the effect of which being more intense in hydrogen than in ethylene, and more in ethylene than carbonic oxide. He succeeded in repeating the phenomena with palladium wire, but failed with silver, gold, iron, copper, and zinc. He says, that Sementini, presented him in, 1819, with a lamp, "in which alcohol burnt without flame, by means of fine coils of silver wire." Davy suggested an electro-chemical explanation of the phenomena.

Although Davy was the first chemist to observe and record an instance of surface combustion, he was far from recognising that *all* incandescent surfaces are equally capable of effecting it, which, we shall see later, is our modern conception of the phenomenon. He believed that a *metal* surface was necessary, preferably a metal of the platinum group.

During the twenty years following Davy's discovery, several distinguished chemists, investigated the matter. Dulong and Thénard found that the power of inducing the slow combination of gases is possessed in varying degrees by all solids, dependant upon their specific characters, physical texture, and temperature. Thus whereas finely divided platinum can bring about the combination of hydrogen and oxygen at the ordinary temperature, gold and silver require a temperature of 160° to 250° C.; whilst non-metallic substances, such as charcoal, pumice-stone, porcelain, rock crystal, and broken glass, do not become active until 350° C. No experiments were made at that time with these substances in a state of incandescence, the observations being confined to inducing of slow combustion at low temperatures. Other chemists confined their attention to metals of the platinum group, and in 1825 Dr. Henry found that when a platinum ball was immersed in a mixture of equal volumes of electrolitic gas ($2H_2+O_2$) and ethylene, the hydrogen alone was burnt, none of the hydrocarbon disappearing unless the original mixture contained a much larger proportion of oxygen. This new observation, viewed in the light of Graham's subsequent researches upon the occlusion of hydrogen by metals, led to the idea, first put forward by the Italian physicist Fusinieri, that the power possessed by a metal of inducing combustion depends upon a condensation or occlusion of the combustible gas (hydrogen particularly) at the surface, whereby it is rendered more than ordinarily active by association with the surface. He did not think that the oxygen of a combustible mixture was similarily affected by the surface.

The mechanism of induced slow surface combustion formed the subject of a celebrated controversey between Faraday and De la Rive in 1834–5. De la Rive held the view that it consists in a series of rapidly alternating oxidations and reductions of the surface. Faraday, on the other hand, contended that the function of the surface is to condense both the oxygen and the combustible gas, thus producing in the surface layers a condition comparable to that of high pressure. But, owing to lack of crucial experimental data, no satisfactory theory of the process could be evolved. In 1836 interest in the subject suddenly dropped, and was not revived for more than half a century.

Meanwhile, the researches of Deville upon the dissociation of steam and carbon dioxide at high temperatures, in which he had employed incandescent surfaces, had begotten the wholly mistaken notion that because such surfaces promote dissociation they must necessarily hinder combustion, and therefore that in furnace design and construction the contact of burning gases with hot surfaces should be avoided. The late Frederick Siemens strongly upheld this view, and such was the weight of his authority in all matters relating to large-scale heating operations, that his dictum was accepted without question by technical men for a generation. Seeing that Siemens's views exercised such an enormous influence upon contemporary thought and practice, it may be of interest if we consider them at close quarters. He was of the opinion that, inasmuch as "a flame consists of a chemically excited mixture of gases, whose particles are in violent motion * * * it follows that any solid substance brought into contact with gases thus agitated must necessarily have an impeding effect on their motion * * *; in the immediate neighborhood of such surfaces the combustion of the gases will cease altogether, because the attractive influence of the surfaces will entirely prevent their motion." Moreover, in referring to the influence of dissociation, he pointed out that Deville and others had made use of small vessels of special material, and that the results depended very much upon the various kinds of surfaces employed, which by some peculiar influence upon the surrounding gaseous medium had directly caused the dissociation effected. Hence, he concluded "That solid substances have a twofold influence on combustion, because they interfere with the rapid motion of the gases necessary for combustion; and, in the second place, they cause dissociation * * * and by doing so, of course, a great amount of heat is lost." And, further, that "Complete combustion is impossible whenever live or active flame is allowed to come into contact with any solid surface."

No one has greater admiration than myself for the scientific work of Siemens, and the benefits which have resulted from his teachings as a whole; but, in the interests of scientific truth and technical progress, I must point out that he was wrong, and misled others, in his conception of the influence of surfaces upon combustion. It is, of course, true that a *cold* surface thrust into a flame will cool the layers of combining gases in its immediate vicinity below the ignition temperature, and so prevent the completion of combustion; but this does not apply to a *hot* or incandescent surface, which undoubtedly accelerates combustion. If an incandescent surface accelerates the dissociation of steam, it must also accelerate the combination of hydrogen and oxygen. Moreover, Siemens never appeared to have contemplated the possibility of a high temperature *flameless* combustion, much less that such combustion, if realizable, will be a faster process than ordinary *flame* combustion.

The late Thomas Fletcher, who did so much in the direction of developing the uses of gas in small-scale operations, seems to have arrived at a clearer conception than any of his contemporaries of the influence of surfaces in combustion. In a lecture at the Manchester Technical School in 1887, entitled "Some Curious Flames," he demonstrated the possibility of realizing a flameless incandescent surface combustion in contact with metals other than those of the platinum group. He said, "I will now dispense with flame altogether, and show you the same quantity of gas and air burning as before, but in the most perfect form, the combination taking place on the surface of the substance to be heated without any flame. To show this so that all can see, the mixture of gas and air is directed on to a large ball of iron wire, flame being used at first to heat the wire to the necessary temperature to continue the combustion. By stopping the gas supply for an instant the flame is extinguished, and the combustion is now continued without any flame, but with an enormous increase in the heat obtained. This invisible or flameless combustion is only possible under certain conditions; and one essential point is that the combustible mixture shall come into absolute contact with a substance at a high temperature which is capable of absorbing the heat as it is generated. . . . In the absence of a solid substance at a high temperature, it is impossible to cause combustion without flame; and when a flame is used it is also impossible to make it touch a cold surface."

Circumstances during the "nineties" directed the attention of chemists again to the possible influence of hot surfaces upon gaseous reactions. For example, the persistent attempts of the late Victor Meyer and others to determine accurately the ignition temperatures of explosive mixtures were largely thwarted by irregularities which could only be attributed to the action of the hot walls of the containing vessels; and experiments by other workers upon the velocities of chemical changes in gaseous systems led to results difficult to understand, except on the supposition of the intervention of some surface action. Thus, for example, results obtained by Bodenstein in 1899 for the velocity of the interaction of hydrogen and oxygen in porcelain vessels at temperatures between 482° and 689° C. were obviously at variance with the supposition that the gases were combining *homogeneously* throughout the whole volume, and it was in trying to find some explanation of the curious irregularities revealed by a close study of his work that I first became convinced of the supreme importance of the "surface factor" in gaseous reactions. And a perusal of the earlier literature, and especially the experiments of Dulong and Thenard, led me, in 1902, to undertake a systematic experimental investigation of the whole subject.

It is now generally recognized by chemists that all hot surfaces have an accelerating influence upon chemical change in gaseous systems; or, in other words, that if at any temperature a gaseous system A tends to pass over into another system B, contact with a solid at that temperature will accelerate the process. Many examples in proof of this could be quoted, of which I may mention two as coming within my own experience:—

1. At high temperatures methane decomposes directly into its elements, according to the reversible equation:

$$CH_4 \rightleftarrows C + 2H_2,$$

and experiments in which the gas was heated in porcelain tubes to various constant temperatures, between 800° and 1150° C., proved that the change is entirely a surface phenomenon; the gas decomposed only where it was in contact with the walls of the tube, and not throughout its main mass. Packing the tube with fragments of quicklime immensely increased the rate of decomposition. Thus, in two experiments at 1000° C., in the first, without any packing and only the hot walls of the tube exposed to the gas, about 20 per cent. of the gas was decomposed in 25 minutes; in the second, with a packed tube, 96 per cent. disappeared in the same time. In fact, the packing of the tube had a much greater accelerating influence than raising the temperature from 1000° to 1150° without the packing.

2. If a mixture of hydrogen and oxygen in their combining proportions (electrolytic gas) be maintained in an enclosure with smooth glass walls at a temperature of, say, 450° C., there would certainly be a tendency to form steam, but the rate of change would be negligibly small. If, however, there be brought into the system some porous solid material at the same temperature, so that a large surface is exposed to the gases, the rate of change would at once be rapidly accelerated in the layer of gas immediately in contact with the hot surface. Steam, the product, would diffuse outwards from the surface, and the supplies of hydrogen and oxygen at the surface would be renewed by diffusion inwards. Thus combustion would proceed at the surface until the transformation of the original electrolytic gas into steam was complete. In the circumstances cited the rate of combustion, although now quite measureable, would probably be insufficient to cause any self-heating of the enclosure. The temperature would remain at 450° C., which is well below either the ignition temperature of the combustible mixture or the point at which a solid would attain even incipient incandescence.

It is therefore necessary to distinguish between two possible conditions under which gaseous combustion may occur, namely (1), *Homogeneously*—that is to say, equally throughout the system as a whole, at temperatures *below* the ignition points *slowly* and *without flame*, and at temperatures *above* the ignition point—*rapidly* and *with flame;* and (2), *Heterogeneously*, or only in layers immediately in contact with a hot or incandescent surface ("surface combustion"). It is also necessary to remember that the heterogeneous surface combustion is a faster process than the normal homogeneous combustion of ordinary flames.

My own researches began with an attempt to elucidate the factors operative in the combustion of hydrogen and of carbon monoxide in contact with various hot surfaces (porous porcelain, fireclay, magnesia, platinum, gold, silver, nickel, copper and the oxides of copper, nickel and iron) at temperatures below 500° C. The experimental method consisted essentially in circulating the reacting gases at a uniform rate, in a closed system, over the particular surface under investigation, maintained at a constant temperature, provision being made for the rapid removal of the reaction product from the system, either by condensation or absorption, so that the rate of combination could be measured by observing the pressure in the apparatus at regular intervals of time. The apparatus (Fig. 1) comprised a "capacity bulb," *A* (1200° to 1500°); a furnace, *D*, in which the surface under

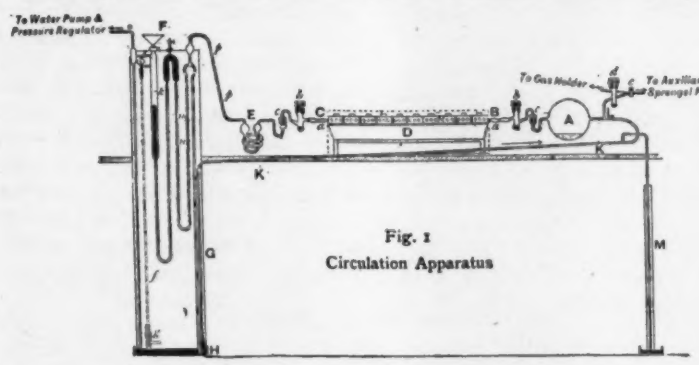


Fig. 1
Circulation Apparatus

investigation, contained in a Jena glass combustion tube, was maintained at a suitable constant temperature; an automatic Sprengel pump, *G*, which kept the gases circulating through the system at a constant speed. At *E* was inserted either a cooling worm for condensation of steam, or a series of absorption bulbs for the removal of carbonic dioxide by a solution of recrystalized baryta. *M* is a mercurial manometer for the measurement of pressure.

Although a great variety of surfaces were examined over wide ranges of temperature, these characteristic features were found to apply in nearly all cases.

1. The catalyzing power of a new surface usually increases up to a steady maximum, after which, provided the gases are present in their combining ratios, the rate of combustion is always directly proportional to the pressure.

2. When the gases are not present in their combining proportions, the rate of combustion is usually proportional to the partial pressure of the combustible gas, which thus becomes the controlling factor. In exceptional cases the rate of combination is strictly proportional to neither of the two gases, but controlled more by the partial pressure of the oxygen than by that of the combustible gas.

3. The catalyzing power of a surface can always be stimulated by previous long exposure at the experimental temperature to the combustible gas. Again, in exceptional cases, similar effects have been observed after exposure to oxygen; but, generally speaking, previous exposure to oxygen reduces, if anything, the activity of a surface.

The principal conclusions established by the experiments are:—(*a*) That the power of accelerating gaseous combustion is possessed by *all* surfaces at temperatures below the ignition point, in degrees dependent upon their chemical characters and physical texture; (*b*) that accelerated surface combustion is dependent upon an absorption of the combustible gas (and probably also of the oxygen), whereby it (by the surface) becomes "activated" (probably ionized) by association with the surface; (*c*) that the surface becomes electrically charged during the absorption of the gases (*negative* for the combustible gas and *positive* for oxygen), the charging being due to ionized gas leaving the surface; (*d*) certain important differences from a chemical point of view between homogeneous combustion in ordinary flames and heterogenous combustion in contact with hot solids have been established, so that there can be no longer any doubt as to the reality of the phenomenon.

The fact that such catalytic combustion depends upon an intimate association of the surface with the combining gases is beautifully illustrated by two photomicrographs of a silver gauze taken *before* and *after* experiments, in which it was employed as the catalyzing medium for the combination of hydrogen and oxygen at 400° C. Fig. 2 shows the original smooth condition of the surface, and Fig. 3

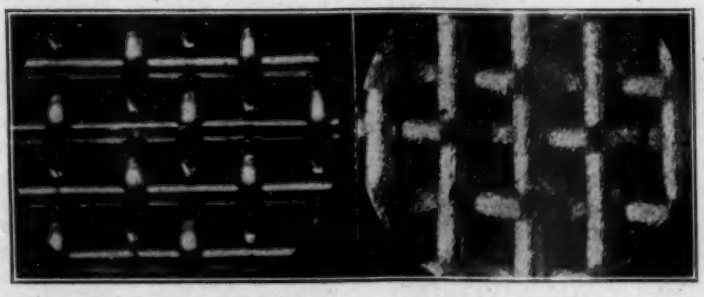


Fig. 2. Fig. 3.

frosted effect produced by the pitting action of the reacting gases during their absorption and "activation" by the surface.

Flameless Incandescent Surface Combustion.—My next contention is that if hot surfaces possess the power of accelerating gaseous combustion at temperatures below, or near the ignition point, the same power must be manifested in greater degree at higher temperatures, and especially when the surface itself is incandescent. Indeed, there are experimental grounds for believing that not only does the accelerating influence of the surface rapidly increase with the temperature, but also that the differences between the catalyzing powers of various surfaces, which at low temperatures are often considerable, diminish with ascending temperatures until at bright incandescence they practically disappear.

The considerations I have explained convinced me some years ago that if an explosive gaseous mixture be injected on to or forced through a porous refractory incandescent solid under certain conditions, which will be hereafter explained, a greatly accelerated combustion would take place within the interstices or pores, or, in other words, within the boundary layers between the gaseous and solid phases wherever these may be in contact, and the heat developed by this intensified combustion would maintain the surface in a state of incandescence without any development of flame, thus realizing the conception of flameless incandescent surface combustion as a means of greatly increasing the general efficiency of heating operations.

Some critics while admitting the accelerating influence of an incandescent surface are sceptical about the process being really flameless. The force of such objections largely disappears when we get into close quarters with the phenomenon and realize how extremely slow a transaction flame combustion really is considered in terms of molecular time. Take, for example, the case of such a quick burning mixture as electrolytic gas ($2H_2 + O_2$). When this is ignited at atmospheric pressure, the flame is initially propagated by conduction with a uniform slow velocity of 20 metres per second, and during this initial period of "inflammation," which corresponds to the conditions of ordinary flame combustion, the total duration of chemical change in each successive layer is something like $\frac{1}{75}$ second, an interval of at least one hundred million times as long as the average interval between successive molecular collisions in the gas. Even after "detonation" has been set up in the mixture, when the combustion is propagated from layer to layer as a wave of adiabatic compression, at a velocity of 2,820 metres per second, the total duration of chemical change is still of the order of $\frac{1}{7000}$ to $\frac{1}{15000}$ second, or about a million times as long as the interval between successive molecular collisions.

The setting up of "detonation" is one, but not the only way in which ordinary flame combustion can be accelerated and intensified; another way is by bringing into operation the powerful "catalytic" action of an incandescent surface, in the manner which I have already indicated, whereby the whole chemical action is concentrated at the surface, and instantly completed there, *without development of flame.*

To illustrate how a flame may be extinguished by the introduction of an active catalyzing surface, I will perform an experiment first exhibited by my colleague Professor Strutt. Most of you will be familiar with his discovery of the active modification of nitrogen produced by a powerful electric discharge. This bulb (capacity 300 c.c.) is full of rarefied nitrogen, at a pressure of about $\frac{1}{16}$ mm.; and in the side tube lies an oxidized copper wire, which fits it as closely as is consistent with easy sliding. If now the nitrogen in the bulb be subjected to a powerful electrodeless discharge, it is transformed into an active condition; the gas, as you see, continues to glow brilliantly, owing to the fact that the "active" modification is reverting to the ordinary kind producing a luminosity which may be regarded as a condition analogous with flame. The glow will last for a minute or more during the progress of the chemical reversion, and finally dies out when the latter is completed. But if, on repeating the experiment, the bulb be turned so that the oxidized copper wire drops into the glowing gas, the luminosity is instantly extinguished. This shows that the reversion process is so enormously accelerated by the surface that practically the whole of the chemical action is concentrated there and instantaneously completed thus extinguishing the glow. I think we have here a close analogy to what I conceive as occurring when an incandescent surface is employed to accelerate ordinary gaseous combustion; the action is so concentrated at the surface that a substantially flameless effect results.

There are two further points which I particularly wish to make clear. In dealing with gaseous interactions at high temperatures, it is necessary to think in terms of what I may call molecular dimensions. Our ordinary units of time, space and mass are altogether

too gross, and must be discarded if we wish a true mental picture of the mechanism of combustion. When, I speak of combustion as occurring "within the interstices or pores" of an incandescent solid, it must be understood that I mean porosity in a molecular sense. A solid may appear dense, and yet be highly permeable to the molecules of a gas; from this point of view only vitreous surfaces, such as glass are, relatively speaking, nonporous to gases, and even glass when it becomes devitrified is sufficiently porous to induce a slow surface combustion.

Next I want to emphasize that the incandescent solids plays a specific role in surface combustion; it is no more idle looker-on at the surging crowd of reacting molecules. On the contrary, it so galvanizes and incites the dormant affinities between the combustible gas and oxygen, that ordinary combustion gives place to the wild intoxication.

The manner in which the surface acts is still a matter of conjecture, but the fact that it so acts can no longer be disputed. In a discussion at the British Association in 1910, Sir J. J. Thomson insisted that combustion is concerned not only with atoms and molecules, but also with electrons, *i. e.*, bodies of much smaller dimensions and moving with very high velocities, and suggested that in reference to the influence of hot surfaces in promoting combustion it was not improbable that the emission of charged particles from the surface was a factor of primary importance. It is known that incandescent surfaces emit enormous streams of electrons travelling with high velocities, and the actions of these surfaces in promoting combustion may be found to depend on the fact that they bring about the formation of layers of electrified gas in which chemical changes proceed with extraordinarily high velocity.

I have endeavored in this lecture to trace the historic development of the idea that hot surfaces have an accelerating action upon combustion, and to explain my own conception of *flameless incandescent surface combustion*, which phrase, together with the shorter term *surface combustion*, I was the first to apply to a definite condition which my researches had proved to be a distinct phenomenon, distinguishable from homogeneous flame combustion.

It so happens, however, that subsequent to my visit to America in October, 1911, when I demonstrated and expounded my discoveries before the American Gas Institute at St. Louis, the Chemists' Club, New York, and the Franklin Institute, Philadelphia, Professor C. E. Lucke, of Columbia University, New York, on the basis of some experiments which he made about 1903, and without reference to my later discoveries, has endeavored, without due acknowledgment, to apply the principles disclosed therein to certain domestic and small scale heating operations, on lines already substantially laid down by me. And in connection therewith he has used the term "surface combustion" in a sense which I believe to be as scientifically unwarranted and fundamentally unsound as it is different from that in which it was first used by me.

Professor Lucke disclaimed the operation of catalytic action in his 1903 inventions, which, indeed, were based upon quite other conceptions, and aimed at burning explosive mixtures of gas and air non-explosively and continuously by the use of appliances which (as he thought) would ensure the maintenance of a steady "*flame cap or surface of combustion*" in a given zone, where the velocity of flow of the explosive mixture is just equal to the velocity of back-firing. Apparently he did little or nothing between 1903 and my visit to America in 1911 to develop his ideas, but since 1911 he has resumed and, profiting by the great interest aroused by my lectures and experimental demonstrations, he is now appearing as a pioneer in "surface combustion."

In the course of the discussion following a lecture which he gave October 14th, 1913, to the American Gas Institute upon "The Design of Surface Combustion Appliances," he delivered himself of the following curious conception in reply to the question: "Why does the name surface combustion apply to this method?" The answer given by Professor Lucke was:

"Gas burning alone would give a big volume of flame. The flame itself would fill much space. By using pre-mixed air with the gas the flame volume is reduced. The total cubic feet occupied is less and less, until just at the combining proportions the flame volume becomes zero and is replaced by a surface instead" * * * (there) * * * "will be length and breadth of flame without any thickness, so it is surface combustion.

In answer to a further question as to where the temperature would be developed, he replied, "Right where the flame is." And on being further asked, "On the surface?" he replied, "Where the flow velocity is equal to the rate of propagation."

A scientific investigator must expect to find other workers anxious to adopt and apply the results of his discoveries, and I do not complain of Professor Lucke helping forward in America the development of principles which I first demonstrated there in 1911, although I think he ought to have made due acknowledgment of that fact. But I must protest against his recent attempt to confuse his previous notion of a "flame cap or surface of combustion" (which I believe to be erroneous) with my later conception of "surface combustion," inasmuch as the two are not only clearly distinct, but mutually incompatible.

Up-To-Date Gas Lighting.

[Written by J. P. CONROY for the New Jersey State Gas Association.]

When I received notice that I was expected to read a paper on this subject there was considerable doubt in my mind as to how broadly I would be expected to cover it; but knowing that there was another member, in the same line of business, assigned the subject, it occurred to me that all that was expected of me was to edit in as concise a form as possible the latest things we have to offer in gas lighting.

Gas arc lamps, as you know have become a recognized standard, and are made in many different sizes and styles, to suit almost any condition or surrounding; and there has been no material change in them the past year.

There has been a demand for several years for some simple, effective and practical means of distance control of gas lamps, and while many devices for this purpose have been tried from time to time, including pneumatic valves, magnetic valves, independent pilot lines, and single valve controls, for various reasons from our standpoint such arrangements have been at best only a partial success. However, in the past year, we have produced what is known as the Humphrey Mercury Valve control, and at this writing several thousand of them have been made and sold. They seem to meet with great favor, and we have yet to receive the first serious complaint of their failing to give satisfactory service.

The workings and control of this valve are so simple that a great many seem unable to understand how such results can be obtained. Therefore, we may state briefly that the regular valve on a Humphrey 30 or 50 either indoor or outdoor lamp is removable and can be replaced by a mercury valve, having a mercury well in it so arranged that the gas must pass up into the well through tubes and return by a main tube to the nozzle. A double shell or float is in this well, the inner shell short, the outer shell long enough to maintain a gas seal at all times. The well is filled with mercury to about ¼ of an inch from top of tube and the float placed in it, the float weighted so that it will lift at about 15 tenths pressure. Then a by-pass valve is placed in the riser or line of pipe leading to lamp and the by pass adjusted to pass enough gas to keep the pipe leading to the lamp filled with gas under a pressure of about 10 tenths, and keep the pilot burning, the gas burned by the pilots preventing building up pressure in the line. When the main valve is turned on it instantly increases the pressure, lifts the float and the lamps light at once. There seems to be no limit to the number of lamps or distance from the control that this system will operate. The reason for this is that, unlike other systems tried, the main supply line to the lamp is not drained of gas, but is kept full under low pressure; and these mercury valves work like a pressure wave lighter, a system widely used abroad for lighting and extinguishing city street lamps from one control. As yet these valves have been made for use on gas arc lamps only, but, no doubt, they will soon be made to suit all forms of gas lamps. It must be remembered that this system requires no special piping, only a by-pass valve in the line leading to lamps. Existing piping systems in stores, offices or elsewhere can be utilized, and it affords an excellent means for the lighting and extinguishing of outside lamps, or lamps in churches, halls, lodge rooms, theatres, moving-picture places, or anywhere that distance control is desired.

A manufacturer of gas-illuminated signs in Brooklyn was quick to see the advantage of this system, and has built a sign illuminated with an outside gas arc lamp, and recommends the use of this mercury valve control, so that signs may be hung at any height from the sidewalk and perfectly controlled by a by-pass valve in the line at the most convenient point in the pipe either inside or outside the store.

This system seems to be a very sharp step forward for gas lighting,

and places us on a par with electric-lighting control. A perfect, positive pilot light or other means of lighting the gas seems to be about the only further progress that can be made in the direction of distance controls. We have tried every conceivable way to find defects in this system, and so far the only attention necessary and the only reason we can see why the valve would not last as long as the lamp is a slight evaporation of the mercury; and it may be necessary to remove the well-cap and add a little mercury, say, every six months.

Semi-Indirect Lighting.—In years gone by it was considered that electricity as a means of ornamental or decorative lighting had no equal, but as we progress in gas lighting this concession toward our competitors seems to be diminishing. The inverted gas arc lamp, single-burner or arc-lamp types, with an enclosing globe, was a very marked stride forward in decorative lighting, and we thought then we had about reached perfection. Still, there is nothing as yet introduced in the way of a lighting fixture that gas lighting applies itself so readily to as semi-indirect fixtures, for the reason that heat follows largely the direct rays of light, and in semi-indirect lighting the heat, with the light rays, are deflected toward the ceiling, and therefore it helps greatly to overcome the objection of heat from gas lighting. Again, as the gas is burned in a large open bowl, it gives the heat a chance to spread out and be dissipated into the air in a broader space about the fixtures, and does much to overcome the difficulty of blackening the ceiling directly above the fixtures, as is the case with the ventilator lamps. Most of you are familiar with our present type of white enamel semi-indirect lighting fixtures that have been on the market for the past year. These fixtures have proven very effective and practical for ordinary places where a shadowless lighting effect is desired, such as printing establishments, accounting rooms, etc. But there is a demand for a more ornamental fixture of this type for dancing halls, cafes, libraries, etc., and with this in view we have designed and are just now placing on the market a semi-indirect fixture similar to those shown in the lighting effects of the N. C. G. A. show in Philadelphia.

The fixture is designed with three or four hollow ornamental stems leading from a point just below the canopy downward and outward to a special constructed ring fitted just inside the ornamental ring that holds the bowl. The gas to the burner proper is passed down through one of those hollow tubes to the burner proper and another tube is utilized as a pilot tube. This construction enables one to use a distant control valve in the canopy at the top of the fixture without disturbing the general construction in any way. The special ring inside the bowl receives the carrying tubes and carries all valves, burners and like construction. The ornamental bowl-ring is hinged and there are catches on the ring so the bowl can be swung down for cleaning and renewing of mantles without disturbing the general construction in any way. The burner being of special side supply, the valve is located at the outside of the ring where it is operated by a single chain pull and does not conflict with the bowl in any way. Such fixtures are now ready for the market and will shortly be furnished in different sizes, finishes and styles and will be the standard to carry any style bowls on the market. All things point to a very large sale of this style of fixture. It is not for us to predict how extensively such fixtures will come into general use. There is but one serious drawback. It is known that there is a very large percentage of absorption of light in this system of lighting, and to the smaller merchants where the greatest efficiency is essential, or in places where very dark goods are shown such as clothing stores and other such places, no doubt direct lighting will prevail.

The progress in commercial lighting seems to have struck a very rapid pace in the past few years and there are places where they stop at no expense to secure certain lighting effects; and it must be our aim to meet every demand and condition, but still, lest we be carried away by these new fixture designs, let us remember after all the number demanding those special ornamental decorative but inefficient lamps or fixtures are much in the minority. The masses will continue to require and demand the more inexpensive, efficient and practical lighting fixtures; and as it is this great aggregate of small stores that largely make up our gross output of gas, in our enthusiasm to secure the few installations of more ornamental lighting effects, let us not forget our main business in the practical and efficient lamp.

THE municipally owned electric plant versus the Gas Co., controlled by private capital, is a competitive experiment at Jacksonville which is being watched with interest. The city plant has recently invaded the field of heat and power by establishing a rate of 2 cents per kilowatt hour for current used for these purposes, and a cut in the gas rate followed. "Cheaper than gas for cooking" is the claim of the men behind the municipal works.

Spheroidal Gasholder Tanks.

By PAUL SEUROT.[1]

The usual formula giving the thickness e of the plating in a gasholder tank is:

$$e = \frac{H\,D}{2\,K\,S},$$

in which H is the height of the tank, D its diameter, K the ratio of the strength of a riveted section to the strength of the solid section, S the unit-stress.

The intention of the designers of the spheroidal tank, the Machinenfabrik Augsburg-Nürnberg, is to replace the straight vertical wall of the tank, subject to unequal stresses and necessarily very thick, by a curved and flexible wall stressed equally at all points. This curve follows exactly the natural curvature of a drop of water or of a thin rubber-silk bag filled with water, suspended by a string and resting on a flat unyielding base (see Fig. 1 and Fig. 2) this bag and its contents then take such a shape or position of equilibrium that there is no shear in the shell at any point, the stress being purely tensile.

As pointed out in the article in *Engineering News*, of June 25, the tank cannot be a closed figure and the meridian tension must be counteracted by vertical struts. This is shown in Fig. 3. The resultant force at A is tangential and acts along line AF. This force is resisted by a circular horizontal built beam AA', and by the vertical struts DAB, which are connected together by X braces.

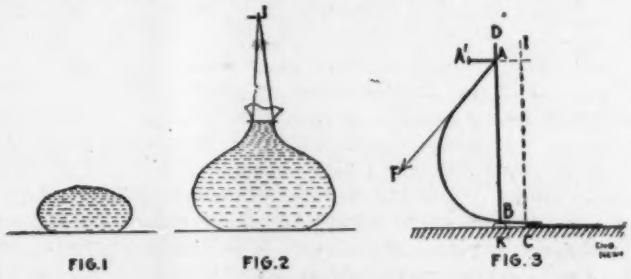
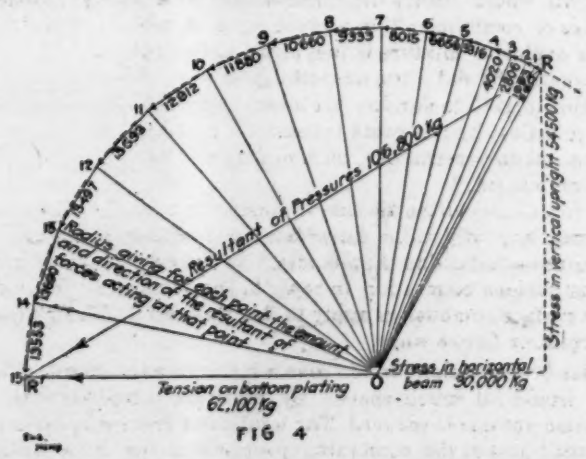


FIG. 1 FIG. 2 FIG. 3

The vertical struts are carried on foundation blocks K through the tank plating. The cylindrical volume of water within surface IC is supported directly by the bottom plating and foundation. The volume comprised between IC and the shell produces a downward pressure which is carried through K onto the foundations.

To draw the curve of the shell, let us assume the problem solved and let AB, Fig. 5, represent the curve which is supposed to resist equal tensile stresses at all points. Let us take a slice one meter wide on the circumference of the opening, and let us divide the curve into a certain number of equal parts; in the present example, there are 15 divisions, 1.10m. long each. At the center of gravity of each of these divisions, and normally, let us draw the water pressure, calculated for each point by multiplying the area of the section, its width by its length, by the height of its center of gravity below the top surface. Drawing these forces one after the other, parallel to their direction and proportionately to their value, we get a polygon of forces, Fig. 4, whose closing line RR' is parallel to, and (measured by scale) equal to, the resultant RR' of the several pressures. The lines RO and $R'O$ parallel to the two reactions at the end of the curve give the value of the tensile stresses on the base-plating and at point A.


Radius giving for each point the amount and direction of the resultant of forces acting at that point
Tension on bottom plating 62,100 kg
Stress in horizontal beam 30,000 kg
Stress in vertical upright 54500 kg
FIG 4

1. *Engineering News.*

If we join the intersection of these reactions, in Fig. 4, to the several points of the polygon, we obtain the value and direction of the resultants of all the tensile stresses at each point in the shell. All these resultants must be equal, since the curve is supposed to be such that all the tensile stresses are alike. Therefore, *these lines must be the radii of a circle whose center is the intersection of the reactions*, and passing through the several points of the polygon. In other words, we should be able to inscribe the force polygon within this circle.

If now we draw the equilibrium polygon by laying, at each point of the curve, lines parallel to the rays of the force diagram, the sides of the equilibrium polygon will be tangent to the curve of the shell, and if we started at the lowest point the last side should pass at the top through point *A*.

In practice, the lower and higher points being given, it is customary to draw a trial curve, applying the hydrostatic pressure at each division. The force diagram corresponding to these pressures being drawn, it should be possible to inscribe it in a circumference if the original curve was correct. A few trials may be necessary to obtain the proper curve.

The weight of a tank designed along these lines will be about two-thirds of the weight of a vertical-side tank for the same unit stress.

For instance, for a tank 13m. high and 65m. in diameter, with a unit-stress of 10 kg. per sq.mm., the thickness of the lower plating should be, in a cylindrical tank,

$$e = \frac{65 \times 13}{2 \times 10} = 42\ mm.$$

The thickness at the top would be from 6 to 7 mm. In a spheroidal tank, the thickness *e* would be constant and equal to:

$$e = \frac{62{,}100\ kg.}{950 \times 10} = 6.5\ mm.$$

In practice, a uniform thickness of 8 mm. would probably be adopted.

The above conditions obtain when the tank is full. When the tank is being filled, the tensile stresses induced in the wall are not equal. In order to avoid any deformation of the shell during the filling operation, the shell is connected to the vertical uprights by means of latticed girders (Fig. 6). The rivets connecting the latter to the shell

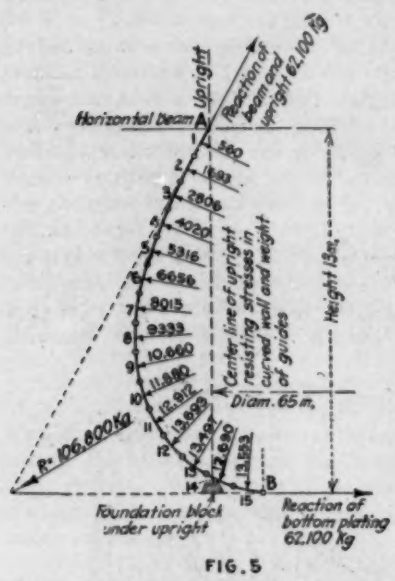


FIG. 5

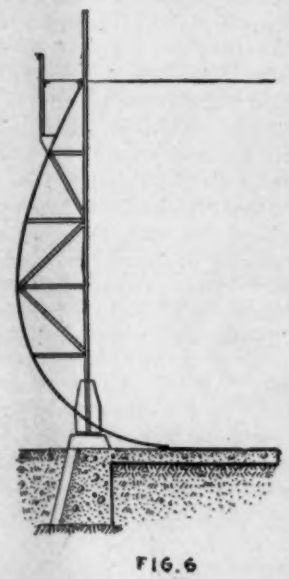


FIG. 6

cease to be under any stress when the tank is full, at which time the latticed girders could be left out altogether.

In the case taken here as an example, the water pressures have been determined as follows:

No of Points.	Development of Skin M.	Length of Skin M.	Area Sq. M.	Head M.	Pressure. Kg.
1.....	1.020	1.100	1.122	0.500	560
2.....	1.040	"	1.144	1.480	1.693
3.....	1.050	"	1.155	2.430	2.806
.....	....	....	....	....	....
.....	....	....	....	....	....
14.....	0.980	"	1.078	12.700	13,690
15.....	0.950	"	1.045	12.970	13.553

The Development and Possibilities of the Gas Water Heater.

[Paper read before the New Jersey Gas Association by Mr. H. J. Long.]

The present importance of the gas water heater, in the list of valuable business getters for gas companies, is not so much the result of development of the appliance as it is an awakening on the part of the gas men themselves. It was only about eight years ago, at a meeting of the National Commercial Gas Association in New York City, that I called the attention of the President to the fact that in all the list of subjects to be discussed, absolutely no mention was made of the gas water heater. At that time it was held largely as a side issue by a majority of gas men, and in a paper entitled "The Relation of the Gas Company to the Gas Water Heater," I called particular attention to the enormous possibilities for their use. At that time the copper coil independent heater and the automatic instantaneous heater had both practically reached the point of perfection as regards economy and service that they render today. So I repeat, a large water heater business does not depend so much on the further development of the appliance as an awakening on your part to its possibilities.

Before going further into a discussion of what we can do to still further stimulate their use, it will not be amiss to consider along what lines the development has been most obvious. In the water heater, as with practically all gas appliances, two vital factors must be kept constantly in mind, these being "Service" with "Economy." The first efforts were naturally along the lines of limited service with correspondingly low operating expense. The use of gas is a gradual education, as the majority of those first using it are predisposed to consider it an expense and not to consider the value of the service rendered. Under those circumstances, at first, water heaters were only an auxillary appliance, to be used in the summer and then only on extraordinary occasions. For such, the cast iron and brass sectional and the 20 ft. coil heater, using from 30 to 40 ft. of gas per hour, were considered entirely suitable. However, once the public used these as an auxiliary and discovered the economy, the cleanliness and unrivalled service rendered, the demand was insistent for *quicker* service. So we find the tendency has been and is to-day to give *quicker* and better *service*, and we have the larger capacity tank heaters, consuming 50 to 60 ft. of gas per hour. Economy is still important, but service is the essential factor. This same demand for *service* has also stimulated the design of special types of heaters for different uses, such as the smaller automatic heater for the barber shop, restaurant and kindred places where the demand is at one point only; the larger automatic for the home; the combination of the automatic instantaneous heater with storage for large requirements, return circulation and low water pressures. So to-day we find some type of water heater suitable for practically every requirement.

Gas, being a flexible fuel, turned on and off at a moment's notice, fills its allotted field to the greatest advantage when used for intermittant service. The heating of water for domestic use is essentially such a service, and gas, therefore, the most suitable fuel that can be used. In any field of human endeavor, that article which renders a given service or fills a certain need better than some other, will meet with the greatest success. The gas water heater meets these requirements in every respect, thus holding out one of the greatest possibilities for the future of any gas appliance on the market. The *need* for the water heater exists to-day and is constantly becoming greater, so that the increase in their use and the broadening of their field is entirely a matter of education. Each year sees this truth verified, for I believe that those who have industriously sowed the seed and tended the soil in educating the public are reaping an abundant harvest in increased sales. We come, then, to the real crux of the situation. The need is present, the demand is there, the appliance perfected; the only remaining factor for wonderfully increased water heater sales is *education*. You, therefore, as sellers of service, must become *teachers*. When I say you, I mean every individual of your force—salesmen, officemen, managers and shopmen—must understand clearly that in your relation to the public you are as teacher to pupil, as missionary to heathen, as the educated to the ignorant. Are you, are your men, prepared to take that stand? Can you go out, develop the *possibilities*, fill the regular requirements, and find new needs in the field of gas water heating? If not, you must first fit yourselves to fill that position.

The gas water heater differs materially from every other gas appli-

ance which you regularly handle capable of wide distribution. Not only is it a gas appliance, but it is also a plumbing appliance, and enters closely into the personal comfort of *every* member of the house hold. Every prospect is a separate problem to be intelligently solved. It is not a case of selling a cheap article at $15 or a better one at $25 or a still better for $50, and so on. For every prospect there is a type of water heater best suited to its individual requirements, regardless of price or personal taste. It develops upon you, therefore, to have such a thorough practical knowledge that you may intelligently meet that condition. The possibilities of the water heater are almost unlimited. Every house, shop, church, store—in fact nearly every building in your city—has possibilities for their installation. I have tried to impress upon you that to develop these, special training and knowledge are required. The problem, then, is how to accomplish this. I would strongly recommend that on every sales force, in any community, you have a water heater specialist in your own ranks. Another vital point is to have a close relationship between the salesmen and the operative men. One handicap under which the average gas salesman labors is the lack of personal touch with the installations. Not only is he unable to see that the appliance is installed exactly in accordance with his ideas to give the service promised, but he is losing one of the most valuable educational possibilities. We learn more from experience than from books, and experience only comes by personal contact with the installation. As an example, after we have made an unusual installation, we test out and experiment, frequently making changes in piping until satisfactory service is obtained. This experimenting is an education which we could obtain in no other way. We have a case now where we have recommended to the salesman a heater which will have to be installed in a certain definite manner to give expected results. If this sale is made and merely goes to the operating man to install it in the regular manner, it will not give the proper service. It is essential, therefore, that the salesman co-operate directly in the installation.

Concentration is the order of the day. Let every man, of course, do all that he can, but the subject is so comprehensive, the possibilities so vast, that to get the widest possible results, one man at least should qualify as an expert. While talking with a manufacturer of specialties the other day, I called his attention to a few of his appliances which had come to my knowledge as not being satisfactory. In each case he showed that the fault was due to using in the wrong way or wrong place, and he made the remark that if he could only see every job and recommend the proper appliances, his troubles and the gas company troubles would be over. How true this is of the water heater. The manufacturers of automatic water heaters maintain one of the most elaborate and expensive sales organizations of any appliance, just so that they can come in direct contact with the consumer and see that the right heater goes in the right place. Here again, success comes with knowledge and it is my belief that with the proper education of the gas man a large part of the present expense, both for selling and maintenance, can be abolished. In practically every case where we are consulted and recommend a certain appliance, the sale when once made, is permanently made to the satisfaction of the customer and the profit of the company.

It has been my purpose to make this paper non-technical, leaving that part to the educational campaign. But I wish briefly to bring before you some of the newer appliances, and some of the special installations which will show some of the untouched possibilities for water heater sales. Due to its extreme simplicity, its low first cost and large service at comparatively small expense, the independent tank heater occupies first place for domestic use. For greater economy per gallon of water, with continuous inexhaustable supply, the automatic water heater is most suitable. There are many conditions, however, which neither the boiler type nor the regular sizes automatic heaters can properly handle, due to varying water and gas pressures, long runs of pipe, isolated fixtures, high first cost and special requirements. The automatic storage system, using a storage tank, with coil heater and thermostatic control gives hot water under these special conditions, but is only partially successful owing to its higher operating expense, due to large radiating surface of boiler and comparative lower efficiency of the storage heater. A recent development along these lines, is a combination of the automatic instantaneous heater, with a small storage incorporated therein, which gives the unlimited service under all conditions, with the low operating cost of the automatic. The small automatic water heater with a 2 gallon per minute capacity has likewise filled a demand that could not be handled as satisfactorily with any other type. The very first heater of this type which we put out, went into a factory building. Placed in the lavatory, it supplied hot water for the men and women, as well as for the scrubbing. For several years it has given perfect service and has been the means of at least three additional sales in the same territory—it is moreover the only gas appliance in the factory. Another installation is in a night lunch wagon, which although mounted on wheels, has gas and water connections. Most salesmen would pass up a lunch wagon for any purpose but a ham sandwich, but this one showed a $55.00 sale for some enterprising member. In another case a meat market uses a heater for warm water for cleaning; and in a hospital is a separate heater for the operating room, giving an immediate supply at any temperature, independent of the coal heated main unit for the rest of the building.

New Brunswick, which was never considered a live water heater town, has through concentration shown up one of the best in the country on this type of heater. Over 50 installations are daily giving a service not possible with any other type at the same original cost and expense of operation. In Hoboken, high upon a wall in a livery stable and connected with a hose, is a No. 2 heater where hot water is required for treating various horse ailments. In a chemical laboratory the heater was such a necessity that, being out of commission for only a day caused them considerable annoyance. In a high school the cooking class are daily using a heater, not only being a gas consumer on its own account, but educating the coming generation of mothers to the necessity of unlimited hot water service. In the bank building a separate heater for the lavatory gives them service independent of the coal heated appliance, which is unreliable and located at a distance, and is a silent reminder to the directors of the advantages of gas over coal. In a photograph gallery, lukewarm water has proved a great benefit, and in the next block, an undertaker finds it a necessity in his business. Several bakeries find that the clear, steaming hot water at the turn of a faucet, helps them materially in the preparrtion of pure food. Recently a large Baptist church specified a coal heating appliance for taking care of the 1,200-gallon baptistry, as well as shower baths, lavatories and a kitchen. The plumber, the architect and the members of the committee were all very skeptical of gas, but after installing two No. 4 automatic heaters, connected tandem, and filling their baptistry with water at exactly the right temperature in 1 hour and 20 minutes, their opinions changed, and from being skeptical, they are all now enthusiastic gas boosters.

Not only for domestic supply, but for heating purposes, you will find a special market. In a plant manufacturing artificial ice, producer gas and electrical power is used, and steam is required for separating the ice from the cans. Placing a 6 horse power automatic gas steam boiler, reduced the time of melting from 4 and 5 hours, to 1½ hours, and give the gas company an income exceeding $1 a day, where formerly there was not even a gas pipe in the building. As an auxiliary heater, one customer, having a hot water heating system, connected a copper coil independent heater to his large dining room radiator. He placed the heater in the basement, directly beneath the radiator and connected into the regular circulating pipes, and it warms the dining room for chilly mornings, without interfering with the operation of the main system when coal heater is started.

In a surgical laboratory, a small room was required to be heated with a variation not to exceed 1°. Coils of hot water pipes heated by a steam plant and an expensive air pressure system of control failed to give satisfactory service; while the installation of two independent tank heaters, controlled by an Ideal Syphon Regitherm, solves the problem in the cheapest and best manner. Moreover, having gas for heating, in another summer, they will be able to dispense with the steam in that building, which means another gas heater for domestic supply.

While out west last winter, during heavy snow storms, I called at one place where all around the building the sidewalk was perfectly clean of slush and ice. Upon investigation, I found that they had a gas water heater and with a hose cleaned the walk perfectly with scalding water. The owner said he had tried everything and that this did the work cheaper and better than any method he knew of.

In a nickle plating plant a coal heater required 1½ to 2 hours to boil the potash and water, with the services of a man all the time. A gas steam heater gives him steam in 10 minutes, has his solution ready in 30 minutes, and is entirely automatic. After 2 years of use, he has just ordered a gas steam heater of double the capacity for his sherardizing plant.

There are, doubtless, within the knowledge of each one present, many other cases of special installations which will serve to empha-

(*Continued on page* 138.)

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NOTICE TO ADVERTISERS.

New Advertisements and changes of copy therefor should be in hand Wednesday noon of week prior to date of issue.

NEW YORK, MONDAY, AUGUST 31, 1914.

[Official Notice.]

Michigan Gas Association Meeting.

Office of the Secretary-Treasurer,
Grand Rapids, Mich., June 29, 1914.

The annual meeting of the Michigan Gas Association will be held at Lake Harbor, Wednesday, Thursday and Friday, September 2, 3 and 4. This decision has just been made by the Executive Committee of the Association and we are sure those attending the meeting will find this departure from the regular practice of holding gas association meetings in the large cities, a most delightful experience.

Lake Harbor is a resort beautifully located on Lake Michigan and an inland lake 4 miles south of Muskegon, Mich. It is reached by Goodrich Boat Line via Muskegon, and by the Grand Rapids and Indiana Railway, and the Grand Rapids-Muskegon Electric Road via Grand Rapids. The hotel accommodates 500 guests, is prettily located and gives excellent service. There is a fine 18 hole golf course, baseball grounds, 9 tennis courts, Lake Michigan bathing beach, fine bath houses, bowling alley, billiards, canoeing and good automobile roads. There is a combination theater and convention hall which may be used for dancing parties as well as for the business sessions of the convention.

There are a number of cottages in connection with the hotel, and it is hoped that members will bring their wives and children, for the resort specially caters to the whole family.

At the time chosen, the association will have the resort practically to itself, and there is enough to do aside from a carefully planned business programme, which will be announced later, to make the trip worth while to any gas man within reachable distance of Michigan. Every gas man is invited to meet with us whether a member of the association or not. The hotel rates are on the American plan ranging from $3 a day without bath, to $4 and $5 a day with bath; and will for this occasion cover the use of the golf course, tennis courts and other features for which there is usually an additional charge. Glenn R. Chamberlain, Secy.-Treas.

[Official Notice.]

Pacific Coast Gas Association, Twenty-Second Annual Convention.

Pacific Coast Gas Association,
Office of the Secretary,
August 22d, 1914.

To the members of the Pacific Coast Gas Association: I take pleasure in advising you of the following arrangement in connection with the 22d Annual Convention of the Association, which will convene at Long Beach, Cal., September 15th, 1914, presided over by Mr. Champ S. Vance, of Los Angeles, Cal.

The address of welcome to the Association will be delivered by Hon. L. N. Whealton, Mayor of the City of Long Beach, and Mr. P. E. Hatch, President of the Long Beach Consolidated Gas Company, will welcome the members on behalf of that company.

Programme.

President's Address, by Champ S. Vance.

1. General Utilization of Gas, by Gas Exhibit Committee.
   a. Gas Street Lighting, by C. B. Babcock.
   b. Gas Lighting in the Home, by R. J. Thompson.
   c. Domestic Use of Gas, by B. S. Pedersen.
   d. Industrial Uses for Gas, by H. P. Pitts.
   e. Water Heating by Gas, by H. R. Basford.
2. The Nature and Extent of the Obligations of a Gas Company to Improve its Facilities and Extend its Service, by C. P. Cutten.
3. The Appliance End of the Gas Business, by P. C. Wickersham.
4. Welding in Gas Distribution, by D. E. Keppelmann.
5. Wholesale Distribution and Measurement of Gas, by John D. Hackstaff.
6. Problem of Pressure Reduction and Regulation, by A. W. Cash.
7. "Safety First," by C. A. Luckenbach.
8. Gas versus Electricity for Cooking, by R. C. Powell.
9. Wrinkles, by H. W. Burkhart.
10. Experiences, by John Clements.

Arrangements have been made with the Southern Pacific Company, Santa Fe Company, Western Pacific, and San Pedro, Los Angeles and Salt Lake Railway Company, whereby members in attendance upon the Convention will be granted a rate of one and one-third fares for the round trip (receipt certificate plan) from all stations in California, such tickets being on sale for the going trip from September 13th to 15th, both inclusive, and will be honored for return trip September 15th to 21st, both inclusive.

The Hotel Virginia at Long Beach has fixed the following special rates:

American Plan—Land side room without bath, one person, $4 per day and upward, with bath, $5 and upward. For two persons, $8 per day and upward; and $9 per day and upward.

Ocean side—without bath, one person, $5 per day and upward; two persons, $9 and upward. With bath, one person, $6; two persons, $11 and upward.

European Plan—Land side room without bath, one person, $1.50 per day and upward; for two, $2.50 and upward. Room with bath, for one, $2 per day and upward; for two, $3 and upward.

Ocean side room without bath, one person, $2 per day and upward; for two, $3 and upward. Room with bath, one person, $2.50 per day and upward; for two, $4 and upward.

The hotel management advise us that they have but a limited number of rooms without bath, and those desiring such rooms should forward their reservations as soon as possible. The Hotel Virginia is one of the best appointed hotels in Southern Californie, and the management of the hotel will leave nothing undone toward looking after the comfort and pleasure of all members and their families; it will be the headquarters of the Association, at which the meeting, the appliance display, and banquet will be held.

The management of the hotel is also arranging the following entertainment for the members and their families:

Tuesday, September 15th; 5 P.M., surf bathing party.

Wednesday, from 4 to 6 P.M., reception and tea to the visiting ladies; and Wednesday night will turn over to the Association the ball room from 9 P.M. to 12 M.

They have also advised that the golf course and the tennis courts will be open to the members of the Association.

On Thursday night, September 17th, a theatre party will be given to the ladies.

Baggage can be shipped by the Southern Pacific or Santa Fe directly to Long Beach, and for those arriving on the "Yale" or "Harvard" steamships, baggage can be shipped via. Salt Lake line. If any of the members should arrive at San Pedro on any of the other steamship lines, it will be necessary to have baggage shipped from San Pedro to Long Beach by express.

The banquet will be on Thursday evening, at 7:30 o'clock, P.M. The price will be $5 per plate and tickets can be obtained from the Secretary during meeting.

Plans are being made for an outing for the members and their families on Friday, full information covering which will be furnished in due time.

It is sincerely hoped by the officers of the Association that the members will avail themselves of the many courtesies which will be extended to us by the Hotel Virginia, in order to show our appreciation of the efforts put forth by the management for our entertainment.

The papers which have been prepared for the meeting surpass all previous efforts and contain the last word on the subjects concerned.

The Gas Exhibit Committee, in addition to the excellent papers which have been prepared by them, have arranged for an up to-the-minute exhibition of appliances, which will be open to the public.

The officers of the Association have left no stone unturned toward making our 22d Convention the usual success, and the appreciation of the members of this fact can be demonstrated in no more fitting way than by their arranging to be in attendance.

Henry Bostwick, Secretary.

BRIEFLY TOLD.

CANNOT REFUSE SERVICE TO ANYONE.—The Appellate Division, by overruling unanimously an order of the Public Service Commission, First District, New York, has made an important decision concerning the obligations of lighting and power selling corporations to the public. C. Perceval, a provision merchant, made application on July 13 last year to the New York Edison Company for a supply of electric current for lighting, power and storage and refrigerating purposes. When the standard forms of contract were sent to him, he struck out the clause forbidding the use of other electric service without the previous written consent of the New York Edison Company, on the ground that he had already contracted for electric current from 7 A. M. to 5.30 P. M. from the Wing Building, next door, which had a private generating plant.

Then the New York Edison Company refused to supply current for only certain hours during the day, and, says the Appellate Division, placed "itself squarely upon the position that it was under no obligation to furnish electric current to any one unless that person agreed to take from the company all the current which he required." Mr. Perceval applied to the Public Service Commission, but it gave a decision in favor of the corporation, and it was from its ruling that the appeal to the Appellate Division was taken.

This court now decides that, in consideration of the privileged position of the New York Edison Company, not the least of which is the right to use the public streets and highways for carrying its conduits, it is bound to serve impartially every member of the community who demands its services. It may, the court acknowledges, establish reasonable regulations which the consumer must observe, but the requirement that a consumer must take all of his electricity from one company or receive none "is not in any proper sense a regulation respecting the use of the service, but is a purely arbitrary attempt on the part of the company to insure to itself a monopoly of furnishing electrical current."

If that were permissible, the court points out, the company could also refuse to furnish current to a consumer who was manufacturing for himself part of the current he needed, and this had already been severely condemned upon grounds of public policy. Moreover, if the company had established the fact that the hours during which the supply of current was asked of it were those in which the greatest demands were made upon its services, this condition could have been met by making a special rate for the service.

So the case was sent back to the Public Service Commission to make such orders as might be proper.

ERRORS IN BILLS NOT BINDING.—That a public utility company is entitled to full compensation for service rendered, although its bills, through the error of an employee, are for a less amount, is the precedent laid down by the New Jersey Court of Errors and Appeals in the case of the Borough of Vineland against the Fowler Waste Manufacturing Company. The borough maintained a power plant, selling current to consumers within its boundaries, and an employee, in reading the manufacturing company's meter, neglected to multiply the face reading by 10, so the company only paid one-tenth of what it actually owed for a period of 2 years. The borough obtained a judgment against the company, which carried the case higher. The judgment is affirmed by the Court of Errors and Appeals.

ATTACK STATE REGULATION.—The attack upon the Wisconsin Railroad Commission eminating from the "Home Rule League," has been analyzed by Dr. C. L. King in the National Municipal Review; and he finds that the evils complained of are no wise chargeoble either against the Commission itself or the principal of State regulation. "The Commission's disregard for local public sentiment," he says, "does not seem to be adequately supported by the facts stated by the league." The league used an analysis of 134 decisions of the Commission and claimed that they showed that the trend of rates was uniformly upward. Of their analysis Dr. King says:

"A survey of the decisions made by the Wisconsin Commission shows that these statistics and percentages are not correct. But even if they were they might be used as convincingly to prove that the public's requests for lower rates were either unfounded or poorly supported, and that the utility companies never asked for an increase of rates unless the increase was clearly justified."

Dr. King also says:

"The supposition that State regulations would do away with *all* expenses to cities to expert service is not well founded. It is expected that the cities would employ such experts as were needed in order to support adequately the cases they brought before the Commission. The Commission cannot be expected to be both judge and prosecuting attorney.

"In making its valuations, the Wisconsin Commission has had as fair a record as any other of the State commissions to date. The League fails to show wherein the Commission is at fault in allowing for costs of establishing the business.

"Now, regulation will be effective only if public service commissions arrive at valuations that are as fair to the public as they are to the companies. The public at large is in need of standards by which valuations may be tested in this light. The League has failed to set these standards. Nor does it show to the satisfaction of even the casual reader of the pamphlet that the Wisconsin Commission has padded valuations."

"The public is in need of standards by which it may test whether its utility commissioners have a public point of view, or are merely adjuncts to the utility companies they are supposed to regulate. The Home Rule League has not adequately supported its indictments against State regulation in Wisconsin."

REGULATION AND BUSINESS.—The question, "Does regulation hurt business?" was discussed by John M. Eshleman, Chairman of the California Railroad Commission, before the Chamber of Commerce of San Francisco not long ago. Figures were quoted to show that there had been a greater development of public utility enterprises since the commission was given jurisdiction over stock and bond issues (March, 1912) than during any other period of equal length in the history of the State. Up to June 30, 1914, the commission had authorized the issue of $284,000,000 in securities, and had denied or dismissed applications for $32,000,000, and was considering applications for issues totaling $82,00 ,000. For the steam railroads of the State in that period there was authorized $126,000,000 of securities; for electric railways, $41,000,000; for gas and electric companies. $80,000,000. Gas and electric companies are spending $80,000,000 for projects under regulation.

Mr. Eshleman said that the California Commission had adopted the principle of protecting a public utility in its field of operation so long as the utility properly performed its duties to the public. Nearly all of the men in control of public utilities regard regulation as helpful, and as an aid in financing new utility projects or the extension of those already established.

On the other hand, rates shown to be discriminatory or unjust had been adjusted to the great benefit of the patrons. He said a public utility was monopolistic in its nature, as it dealt directly with the individual. Alone, the individual was powerless. Simple justice required that the State provide a tribunal to control the relations between the public utility and the individual patrons. He pointed out that jurisdiction over public utilities should embrace the regulation of rates, services and finances, and that the question was no longer, "Does regulation hurt business?" but "shall it be regulation or shall it be public ownership?"

THE ANTHONY N. BRADY MEDALS.—The American Museum of Safety has sent to 1,000 electric railways in the United States the conditions of competition for the Anthony N. Brady memorial medals, which are to be awarded annually to the American electric railway company that has done most to conserve the safety and health of the public and of its employees. A gold medal will be awarded to the company, a replica in silver to the member of the operating staff who has most contributed to the successful record of his company, and a bronze medal to the employee of the company whose services have been of the greatest value in the promotion of health and safety. The first award will be made the latter part of this year, based on the records for the year ending June 30, 1914.

ORIGIN OF MORTAR.—The use of lime as binding material for mortar originated in the remote past. It is probable that some savages when using some limestone rocks to confine their fire noticed that the stones were changed by the action of the heat. A passing shower may have slaked the lime to a paste, and they discovered that the paste was smooth and sticky and was a better material than clay to fill the crevices in their crude dwellings. From this discovery it was but a step to add sand to the paste in order to produce a mortar.

(*Continued from page* 135.)

size the fact that there are on every hand undeveloped possibilities for sales. Mother Earth has always had radium and other untold wealth waiting for the seeker, and concentrated effort of one who knows. Your share of this enormous water heater business depends on how much you know and how hard you seek.

The Kinetic Burner.

By R. F. Pierce.

From a commercial point of view the most obvious need in the gas lighting field is for developments of a revolutionary and spectacular nature. Great as the improvements during the past 5 or 10 years have been, they have been accomplished one at a time and little by little. They are impressive when seen in perspective, but lack the pyrotechnic qualities that inspire redoubled selling effort.

The disadvantages gas lighting has heretofore possessed in the eyes of the public are of a minor sort—annoying rather than formidable—but they have been none the less effective on that account, perhaps even more so. Cracked cylinders resulting from broken mantles; carbonized mantles due to the inability of the burner to take care of an unusual drop in gas pressure; a noisy burner on temporarily increased pressure; discolored fixture arms; unsightly burner parts sometimes obtrusively in evidence; obsolete burners continued in service because of the high cost of more modern types; frequent attention to maintain good operation; all these contribute to a total that even if reduced by one and one would long persist as a rather formidable obstacle in the path of the salesman of gas lighting appliances.

These limitations are inherent in the usual methods of mixing gas and air for combustion. The imperfect mixtures obtained are quite sensitive to changes in gas pressure and quality; to secure high efficiency, it is necessary to provide a chimney closely surrounding the mantle, at such a distance that a broken mantle usually means a cracked chimney or cylinder. Various other features of design, some unsightly and all more or less expensive are necessary in order to secure high efficiency, and the complicated structure which results demands rather frequent cleaning to insure satisfactory operation.

In spite of these obstacles incandescent gas lighting has made tremendous strides during the past 5 years, due in part to various inherent features of a favorable nature—reliability, almost universal facilities for its use, and economy of operation, and in part to the aggressive manner in which both manufacturer of lighting appliances and gas companies have furthered the sale of improved apparatus and fixtures. It is perhaps not generally known that between 1907 and 1912 the lighting service (in candle power hours) represented by the incandescent gas mantles sold was about *tripled*, and that during the same time approximately equal progress was made in electric incandescent lamps. In other words, no appreciable advantage was gained by either, and according to the most reliable estimates obtainable about equal amounts of lighting service were performed by the two illuminants during these years. In other words, the lighting business is still anybody's game, in which the progress of neither need in any way impair the petition of the other. With gas lighting in such a strong position even with the handicaps imposed by the acknowledged shortcomings of the ordinary type of lamp, the development of a new and radically different type, eliminating practically all the frailties of the present type, should stimulate activity to an unprecedented degree.

As was announced in the Journal of August 6th, the kinetic type burner developed by the Welsbach Company, will be placed upon the market immediately. This is the most revolutionary development in gas lighting since the time of Auer von Welsbach, and in connection with the attractive line of fixtures designed for it, embodies the following unique features:

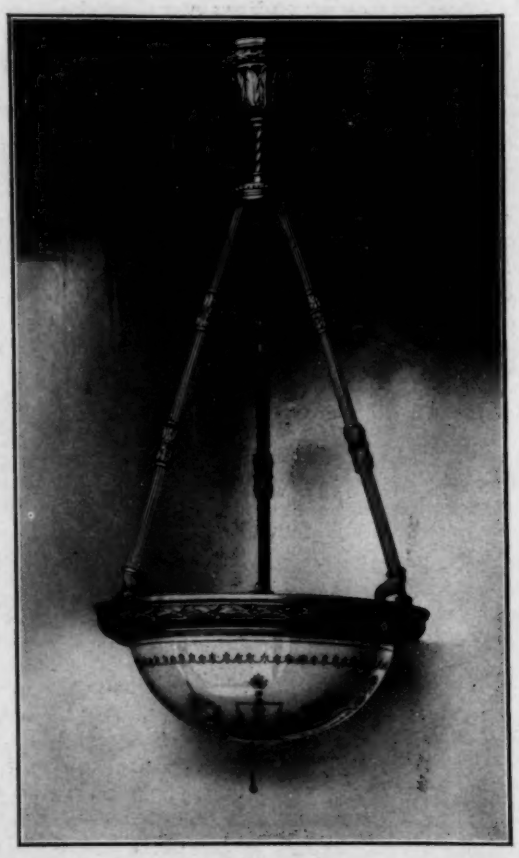
Elimination fixture discoloration.
Greatly reduces ceiling discoloration.
Practically solves the "heat" problem.
Is non-carbonizing.
Requires no chimney or cylinder.
Is inexpensive.
Can be furnished in any size, from 100-candle power to 1,200-candle power.
Requires attention at very infrequent intervals—only one-quarter as often as previous types.
Improves efficiency 50 to 100 per cent.

This has been accomplished by the application of scientific principles in burner design and novel features of construction.

It is well known that in the ordinary low-pressure Bunsen burner the mixture of gas and air is imperfect. The kinetic energy of the gas is largely dissipated in useless eddy-currents, and the mixing of air and gas is accomplished mainly by diffusion, a slow and ineffective process, or by the interposition of gauzes which check the flow of the mixture through the nozzle.

In the kinetic type burner the passages are so designed as to eliminate eddy currents, and the velocity of the gases, due to their kinetic energy, is utilized to further admixture with the primary air. Gauges are necessary to prevent flashing back *only*, and are of such wide mesh and large area that they interpose no appreciable resistance to the flow of gas, and may be subjected to excessive fouling without affecting the performance of the lamp.

The cut shows a semi-indirect fixture equipped with this burner.



The upper mica baffle (which is ordinarily invisible) directs the products of combustion *between* the fixture arms, and diffuses them so that very little ceiling discoloration is perceptible. The lower mica baffle protects the bowl in case of mantle breakage, but does not obstruct the light to an appreciable degree. Since most of the light is directed upward, the effects of radiant heat are imperceptible.

The design of the fixture leaves nothing to be desired in the way of convenience of operation and maintenance, while the simplicity and artistic correctness of the lines and the uniform brightness of the bowl meet the requirements of the most fastidious. The glassware is designed to produce a uniform illumination of the ceiling with a minimum loss of light by absorption. With this fixture all the advantages of the increasingly popular semi-indirect system of lighting may be had with no more expense than direct lighting by the ordinary type of lamp.

This recent development brings effective, comfortable and artistic illumination within the reach of all. Good lighting is no longer a luxury to be envied, but a necessity of which none need be deprived.

The Pavilion Natural Gas Company, which supplies gas to LeRoy, Pavilion, Perry, Mt. Morris and Warsaw, N. Y., on the first of September will put into force a new schedule of discounts, resulting in an increase of 5 cents per 1,000 cubic feet. The reason given for the increase is the expense of operating its lines, and, more particularly, the enactment of the workmen's compensation law.

Tar Formation Temperatures of American Coals.

Bulletin No. 635, of the University of Wisconsin, is a report of investigations covering various grades of American coals to determine (a) temperature limits of the formation, (b) temperature of maximum evolution, and (c) the relative quantities evolved from different coals.

When bituminous coal is fired in a boiler furnace, the volatile constituents are driven off at a comparatively low temperature and appear above the fuel bed. If the air supply over grates is insufficient or cold, or if the volatile matter is chilled by cold parts of the boiler, carbon is deposited as soot or floats out as dense smoke. The practical problem is to cause the volatile gases, carbon monoxide and tar vapors to mix with high-temperature air; a better knowledge of the temperatures at which tars distill, and the rates at various temperatures is then of material aid in designing furnaces and grates for the best firing of the coal.

In coke manufacture, with the introduction of byproduct processes, this information also is of service. Perhaps the most important field of its application, however, is in bituminous gas producer work, where tar vapors are particularly troublesome if carried over to the gas engine. Complete separation of tar is difficult and expensive. Attempts have been made to burn the tar and to "crack" it up into fixed gases.

Tar formation temperatures have to be considered in such efforts—as, for instance, if air is introduced to unite with the tar at the last point where it is evolved in the fuel column, this point is determined by the temperature. In the scheme of drawing tar vapors off the top of the fuel column, introducing them under the grates and drawing tar-free gas off at the center height, such knowledge as mentioned is essential in securing good gas without excessive heat losses.

In the studies undertaken, furnace conditions were similated, but with such apparatus as afforded good control. It was desired (1) to heat the coal slowly and at a uniform rate; (2) to conduct the heat to the center of the coal body by good conductors; (3) to know the temperature of the coal at all times; (4) to sweep out the evolved gases as rapidly as formed; (5) to cool the gases and continuously test for tar; (6) to prevent low-temperature deposition in the pipes and later high-temperature redistillation.

The furnace was a resistance coil design. The coal was held in a cartridge 2½ inches in diameter, with small inlet and discharge pipes for passing inert gas, and a thermometer well. To transmit the heat to the interior, perforated iron disks were packed in the coal ¼ inch apart. The sweeping-out gas was air with the oxygen burned out, furnished under pressure and at full furnace temperature. To test for tar a small stream of the gases direct from the cartridge was chilled and caused to impinge at high velocity on a paper ribbon, any trace of tar showing on the paper. Not quite all the tar evolved is secured owing to the rebound of the smallest and lightest of the tar particles; however, the deposit probably is nearly proportional to the entire tar content. To prevent redistillation the pipe leading out of the cartridge was changed every five to ten minutes.

A study of the tests and results leads to these generalizations:

(1.) Tars begin to distill from any grade of bituminous coal or lignite at about 300° C.

(2.) Maximum evolution is between 375° and 475° C.

(3.) Tars have been all evolved on reaching 550° C. usually, though 600° was obtained with a few coals.

(4.) Formation *temperatures* are not dependent on the geological age of a coal, amount of volatile matter, or carbon-hydrogen ratio in the class tested; tars may appear or disappear at approximately the above temperature with any grade of American bituminous coal.

(5.) No relation is evident between evolved tar and amount of volatile matter in the coal.

(6.) A distinct relation is seen between *amounts* of tar evolved and the carbon-hydrogen ratio. Maximum amounts of thick tar came from coal with this ratio ranging from 13.5 to 18; knowing the carbon-hydrogen ratio of two coals and the tar evolution of one, the yield can be predicted with considerable accuracy for the other.

(7.) The volatile matter of western coal contains fixed gases and watery vapors of low calorific value—shown by small amounts of tar deposited and low-heating value of coal.

The specific data for eleven different coals is given in the table.

Permission for Municipal Rate Reduction Refused.

The application by the Municipal Light Board of the town of Wakefield, asking that the Massachusetts Board of Gas and Electric Light Commissioners consent to the establishment of certain prices for gas and electricity, alleged to be less than cost, has been refused.

The town owns both a gas and an electric plant which it has operated since 1894. The prices which the Municipal Light Board and Manager propose to establish were $1.40 gross a thousand cubic feet for gas, with a discount of 20 cents for prompt payment, or $1.20 net, and 15 cents gross a kilowatt hour for electricity, with a discount of 3 cents for prompt payment, or 12 cents net. The present prices are as follows:

For Gas.—$1.50 per 1,000 cubic feet, with a discount of 20 cents for prompt payment for 100 to 19,900 cubic feet, 30 cents for 20,000 to 29,900 cubic feet, 40 cents for 30,000 to 39,900 cubic feet, and 50 cents for over 40,000 cubic feet a month.

For Electricity.—For light; 18 cents gross a kilowatt hour, with discount of 3 cents a kilowatt hour for prompt payment. Store window lighting; every night until 9 o'clock, commercial lights burning until 12 o'clock, 3 or more arc lights, 18 cents gross, with discount of 6 cents for prompt payment. Moving-picture theatres; 13 cents a kilowatt hour, with discount of 3 cents a kilowatt hour. Signs: 10 cents a kilowatt hour, with discount of 3 cents a kilowatt hour.

For power: 10 cents gross a kilowatt hour to 6 cents a kilowatt hour for 1,500 kilowatt hours or over a month, with discount of 3 cents a kilowatt hour for prompt payment.

In their comment the Board said that the proposed prices obviously deal with the maximum net prices only. No changes in the differential prices heretofore charged were involved, save only so far as such differentials may be absorbed in the new maximum net prices. But it appeared at the hearing that a large proportion both of the gas and electricity sold to private customers is sold at the maximum prices. The reductions proposed were therefore substantial, and might be expected, if made, to cause a considerable, if not a corresponding, reduction in the revenue of the plant.

The manager of the plant has authority, under the direction of the Municipal Light Board, to establish prices, subject, however, to the following provision in the section under which this application is brought: "The price shall not, except with the written consent of

Tar Formation Temperatures of American Coals.

Coal.	Geological Age.	Carbon-Hydrogen Ratio.	Volatile Matter, Per Cent.	Tar Starts, Deg. C.	Temp's Max Tar Deposit, Deg. C.	Tar Ceases, Deg. C.	Per Cent of Sample Deposited on Paper.	Per Cent. of Volatile Matter Deposited as Tar.	Heating Value Unit Coal.
Pocahontas	Carboniferous	19.1	17.95	320	420 to 475	560	0.177	0.988	16,090
Youghiogheny	"	15.8	33.13	280	370 to 540	600	1.705	5.16	15,787
Carterville	"	15.3	31.34	300	380 to 460	520	....	....	14,820
Iowa No. 1	"	13.4	36.63	260 260	360 to 480 350 to 475	540 535	0.805	2.194	14,949
Kentucky No. 2	"	12.7	37.96	375	380 to 620	655	0.351	0.923	14,918
Indiana No. 2	"	12.3	41.75	295 300	370 to 420 390 to 430	545 560	0.55	1.32	14,780
Illinois No. 1	"	12.2	39.24	280 275	370 to 435 350 to 475	580 575	....	....	14,643
Wyoming No. 2	Creataceous	12.2	37.68	300 300	380 to 490 365 to 480	520 525	0 422	1.122	14,542
Iowa No. 5	Carboniferous	11.2	38.59	280	345 to 440	525	0.332	0.86	14,531
New Mex. No. 2	Cretaceous	11.2	36.29	312 318	380 to 450 385 to 460	525 520	0.234	0.64	14,350
Colorado No. 1	Cretaceous	10.6	32.95	270 270	375 to 400 350 to 405	500 515	0.189	0.573	13,523

the Board of Gas and Electric Light Commissioners, be fixed at less than cost, in which shall be included all operating expenses, interest on the net investment in the plant * * * at the rate paid upon the bonds, the requirements * * * to meet such bonds, and also depreciation of the plant, to be reckoned at not less than 5 per cent. per annum of its cost and losses; * * * Such price shall not be greater than shall allow, above such cost, a profit of 8 per cent. per annum to the city or town upon its net investment. The gas and electricity used by the city or town shall be charged to it at cost."

It is the evident purpose of this provision to guard the taxpayers, on the one hand, from being taxed for the benefit of the consumers of gas and electricity, and the consumers, on the other, from being charged too high rates for the benefit of the taxpayers. The rule for securing this, although expressed with apparent clearness, is so broadly stated as to make its application in certain cases extremely difficult, and perhaps not altogether necessary for the reasonable protection of the interests involved.

It is doubtless for this reason that the Legislature, by the expression "except with the written consent of the board of gas and electric light commissioners," indicated its belief that occasions might arise in which a departure from this rule might properly be allowed. This application, therefore, raises the question as to whether or not such an occasion has now arisen in Wakefield. In deciding this question the Board is not called upon to determine what is a fair and reasonable price to be established, nor specifically to approve or disapprove the prices established by the local authorities, but rather to determine whether or not the minimum rates proposed are likely to give proper consideration to the investment made by the taxpayers.

At the hearing it was conceded by the municipal light board and manager that, if the respective costs of the gas and electricity were computed in the mannsr prescribed by the statute, they would doubtless exceed the proposed maximum prices. It was their contention, however, that the method prescribed in the statute was not a fair method of determining the cost, and that the prices proposed would in fact yield a revenue ample to take care of the operating expenses of the plant, its fixed charges and the annual allowance for depreciation required by law. Some question arose, however, as to the amount of the operating expenses and as to the correctness of the records of the output of both gas and electricity. As a result of its investigation of these questions, the Board is convinced that the cost of electricity as computed in accordance with the statute does not exceed the proposed maximum net price. Since the hearing the municipal light board, which has heretofore purchased a considerable amount of current from the Reading plant, has concluded a contract with the Edison Electric Illuminating Company, of Boston, for the purchase in the immediate future of all of its electricity at a price which should affect some saving in its operating costs. There seems, therefore, to be no occasion for action by this Board with respect to the proposed maximum net price of electricity.

As to the differential prices for light and power already enumerated, under which electricity is sold for less than 12 cents a kilowatt hour, it is clear that many, if not all, are less than the average cost of the current computed as defined by the statute. But these rates have been in force for a considerable time, and have secured an amount of business which probably could not have been otherwise obtained, and which has proven advantageous to the plant and the business as a whole. These differentials for electricity were not the direct occasion for this application, and, under the circumstances, the Board sees no reason why it should interfere with their continuance.

With respect to the price of gas, the situation is somewhat different. The Board, from its examination since the hearing, is convinced that the operating expenses alone of the gas business exceed $1 a thousand cubic feet of gas sold. During the fiscal year ending June 30, 1913, they amounted to nearly $1 12; for the calendar year 1913, by reason of larger sales and a somewhat better disposition of residuals, this operating cost was reduced to $1.05. For the past two and a half years it has averaged $1.08. In addition to the operating costs, the statute requires the price to include interest on the investment, the maturing debt requirements and the depreciation reckoned at 5 per cent. on the cost of the plant. There is a fair chance for some difference of opinion as to the amount of the investment, but upon the basis most favorable to the petition of the management, these fixed costs have exceeded 40 cents. Even if depreciation be reckoned at 3 per cent., as is permitted for a different purpose by chapter 411 of the Acts of 1906, and if the maturing debt requirements are omitted, these fixed charges have exceeded 30 cents. The average net operating expenses for the past two and a half years have been $32,700, and the average annual sales, 30,129,375 cubic feet. It thus appears that if all this gas had been sold at $1.20, the resulting revenue would not have been sufficient to pay 4 per cent. on the gas investment and make any provision for depreciation.

In view of these facts it is reasonable to expect that, if the Board's consent is given to the establishment of the proposed maximum net price, all of the gas supplied by the plant to its consumers will be sold at a substantial loss. A reduction in price often stimulates a demand which results in an increased output without a corresponding increase in cost, and the business problem which this fact suggests is always to be considered. But in this case there is no sufficient reason to believe that a loss so substantial is likely to be absorbed by the increase in output to come from the lower price. The last annual statement of the financial condition of the business indicates losses which have not yet been recovered. Without an extensive and thorough investigation it is impossible to determine when or how this loss occurred, and for the decision of the present case this seems to be unnecessary. Some portion of former losses have been recently regained, particularly in the last three years. Until these can be further reduced, however, it would seem to be the part of ordinary business prudence for the town to require consumers of gas to pay all the operating expenses and fixed charges. If it be claimed that the town will make some profit on its electricity supply at the new rates, yet, in view of the great difficulty of an accurate and reliable determination of this fact, it would seem far wiser to await the demonstration which experience may give, and then to consider how far, if at all, the electric business should be made to restore losses in the supply of gas.

In view of the foregoing considerations, the Board has voted to refuse consent to the net price of $1.20 for gas to be sold and delivered by the town of Wakefield, and to dismiss, for lack of jurisdiction, so much of the petition as relates to the net price of 12 cents a kilowatt hour for electricity.

Special English Correspondence.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, August 20, 1914.

The Half Year's Accounts.—War Clouds.—Comparative Valuation of Town Gas.—Vertical Retorts at Burnley.

For more than one reason special interest attaches to the accounts of gas undertakings for the 6 months ended June 30, 1914. The previous 6 months indicated the existence of an unusual position. There was an advanced price of coal and oil, not only without any corresponding advantage in respect to residuals, but, on the contrary, with indications of something approaching a slump in coke, and in sulphate of ammonia. The usual experience has been that the residual market showed some degree of sympathy with that for materials. A booming state of general trade influenced both. But now other and independent influences appear on the scene, and we can no longer depend on a comfortable coincidence that has tided over many difficult positions in the past. It was known that the experiences of the early part of 1914 showed no improvement in this respect, but rather the reverse. The coke market has been, and still is, in a very weak state. Notwithstanding a more extended making of carburetted water gas, the stocks of coke were probably larger on July 1st than they were on January 1st. And sulphate of ammonia has been steadily going from bad to worse. But there is evidence that the bottom has been touched, and that some improvement may be looked for in the second half of 1914. Coal contracts have been renewed at reduced prices, sulphate shows a slight improvement, and as much may be said with regard to coke. Six months ago we were deploring a slight decrease in the sales of gas, not more than might be accounted for by the unusually bright mild weather that obtained during November last, in place of the gloom and fog that has been our usual experience. In most instances this has been more than recovered, and the total sales of gas for the year show an increase. In this respect they have been assisted by 3 months fine summer weather, and the high price of solid fuel, which has led many to consider the comfort in the household and economy in the purse that can be secured by the installation afforded by a gas cooker and bath heater. This is shown by the apparatus sold or supplied on hire. The Gas Light and Coke Company, of London, report 7,358 new consumers, and 23,667 gas

stoves fixed during the six months. And the South Metropolitan Gas Company have, in twelve months, added 5,982 consumers and 14,171 gas stoves. Notwithstanding increased expenses, there is very little talk about increasing the price of gas. As a general rule there is a good balance of profits in hand, out of which deficiencies can be made up, and full dividends will be paid.

During all the years I have written these monthly letters it has never been necessary to allude to National affairs and their effect on our industry. But within the last few weeks a position has arisen that has involved several European nations in the state of war, and Britain has not escaped being drawn into the vortex. Our working staffs have been depleted to a most inconvenient extent by the drafting out of the Army and Navy Reservists for active service. The usual August Bank Holiday has been extended over an additional three days with a view of conserving the supply of gold, and conse quently ready cash is short. This position is to be relieved by the issue of paper money. The whole railway system is under military control, and the prices of food of all kinds are advancing. What the result of this will be it is impossible to say. Some 20 millions of combatants are involved, so the operations will be on a scale hitherto unequalled. It is 60 years since this country was last involved in an European war, and then but a comparatively small percentage of the total population were concerned in it. The present position will leave its mark upon the gas industry. as on most other commercial enterprises of the country.

There has always been a desire to arrive at a common standard of valuation, by means of which an intelligent consumer could compare the price he pays for gas with that obtaining in neighboring towns. The manager of a gas works seeks a similar standard for another reason. He wants to compare his working results. In regard to the methods of arriving at such standards, in both cases the difficulties tend to increase. So long as gas was used for flat flame burners, the price, divided by the candle power, gave a factor, to which the only objection was that the standard Parliamentary argand burner did not necessarily indicate the value of the gas when consumed in a flat flame burner. When gas was made from coal only, and by similar methods of distillation, there was some approximate agreement between the composition of the gas supplied at one works with that at another. The first difficulty came with the gradual changes that have culminated in the replacement of the photometer by the calorimeter. The consumer is now very little interested in the candle power, because he uses 50 per cent. of his gas for heating, cooking, power and technical purposes, and over 40 per cent. for incandescent lighting. So perhaps the best standard for his purpose is the number of heat units supplied for one penny, one shilling, or any other convenient unit of money value.

The manager was for some time accustomed to consider the cost of gas delivered into the holder as compared with the current price of coal, having regard to the quality and description used. And it was a simple matter to value one coal against another. The official form of accounts used by all statutory gas companies enabled him to get at the average cost per 1,000 cubic feet delivered into the holder. He took the working expenses, deducted the receipts for residuals, and thus arrived at a figure which, when divided by the quantity of gas made, gave the desired result. But now he has at least three different systems of carbonization to consider—the vertical, the inclined, and the horizontal—any of which may possibly give the best results as regards quality or yield of gas in respect to a particular brand of coal.

Nor is that all. There is the possibility of using various hydrocarbon fluids as enrichers, enabling him to increase his yield per ton without at the same time sacrificing illuminating value. But this introduces alteration in composition that may affect the matter from a consumer's point of view. And there is also the possibility of supplying a mixed gas, containing anything up to 30 per cent., or even more, of carburetted water gas. The complexity of the problem is illustrated by the absence of anything like agreement in favor of any one particular method or combination. Almost every possible arrangement of working has its votaries, and it is impossible to lay down any special method or combination that can be proved better than any other. We find one important works making 50 per cent. of carburetted water gas, while an equally important neighbor pins his faith to straight coal gas. One adheres to horizontal retorts, while another runs verticals, and so on. No wonder that a committee, formed by the British Association of Gas Managers for the purpose of comparing different methods of carbonization, has retired from the task on the ground that it is impracticable. There are no guiding principles, and therefore every engineer is left to follow his own calculations or ideas. For several weeks past there has been some discussion on this subject in the columns of the *Journal of Gas Lighting*, and last week an anonymous correspondent furnished some interesting figures, extracted from the well-known "Fields' Analyses of Gas Undertakings," that have an interesting bearing in illustration of the point above mentioned. They refer to thirty-three metropolitan and principal provincial undertakings. The make of gas per ton of coal carbonized ranges from 10,240 to 13,472 c. ft., and the illuminating power from 14.23 to 18.08 candles. Nine undertakings do not use oil, and the remainder consume various quantities, ranging from 2.03 to 3.37 gallons per 1,000 cubic feet of oil gas manufactured. The largest consumption of oil does not coincide with the highest make per ton of coal, and no connection is traceable between the two. This is surprising, as one might expect that a high rate per ton would indicate poorer quality, calling for the use of a high-quality oil gas as an enricher. But there are three concerns making over 13,000 c. ft. per ton, and in each case the oil consumption approaches the lower rather than the higher limit. Possibly some undertakings may use cheap, inferior (from a gas-producing sense) coal, and squeeze it dry, although they do not show a high comparative make. The candle power of the oil gas appears to average 7 to 7½ per gallon of oil used per 1,000 c. ft. of gas made. Some further information is furnished by the price of coal, which ranges from 10s. 0d. to 18s. 10d. per ton; but this is probably affected more by the distance from the colliery than by the quality supplied. Some of the undertakings may enjoy the advantage of being situated next door to the best gas coal mines in the kingdom, while others may be 200 miles from the nearest colliery.

The consumers of gas are most interested in the column showing the number of candle feet supplied for one penny, which indicates a remarkable variation not only as a whole, but between neighboring places. A consumer residing within the Metropolis will receive either 476, 513, or 562, according to the locality of his habitation, and if he chooses to move out into the suburban districts, can have the choice of from 413 to 584. In different parts of the provinces the quantity ranges from 413 to 1,085, a variation of 1 : 2½. These figures include the cost of meter rent where such is charged, which must not be overlooked, because some concerns supply meters free, while others charge as much as 2½d. per 1,000 cubic feet of gas as rent. As already remarked, the consumer is not greatly interested in candle power. It would be more useful to him if a fair calorific test was available in each case, so that he could know the number of British Thermal Units supplied for one penny. In view of this variable composition of the gas, the candle power is not of much use as an indication of the heating value.

An interesting experiment with vertical retorts is reported from Burnley. For seven days, early in July, the coal gas was produced exclusively from six vertical retorts, and arrangements were made for accurately checking the working results. During the test 240 tons of coal were carbonized, and the quantity of gas obtained was 3,084,000 cubic feet, showing an average make per ton of 12,850. The illuminating power was 15.1 candles. The consumption of coke in the furnaces for heating the retorts was only 11 per cent. of the coke made, a remarkably low result. The inclined retorts used on the works require 17½ per cent. of coke. These results compare favorably with those obtained with vertical retorts in other places. A mixed gas is sent out at Burnley, but arrangements were made to conduct the test entirely independently and distinct from the carburetted water gas plant. It would be interesting, in tests of this description, if the calorific value and the composition of the gas was also stated. These are the chief points to be considered, in view of the large stocks of coke throughout the country, which make it certain that any surplus, or additional make, must be disposed of at a cheap rate. At Burnley the carburetted water gas may be able to assist matters in this respect, as there is no doubt that the present slump in coke has been assisted by increased production due to many gas works shutting down the oil gas plant on account of the advance in price of oil at the beginning of the year.

No REPORT was made to the Ashtabula (O.) City Council by the committee appointed two weeks ago to investigate the Ashtabula Gas Company in an effort to learn if the ordinance of the company asking for an increase in the price of gas was justified. It is evident that the committee intends to make a thorough investigation of the claims of the company before reporting back to the city council.

New Methods and Appliances.

A PORTABLE METER PROVER.—Mr. G. W. Anderson, who has been appointed Inspector of Meters in Galesburg, Ills., is the inventor of a device for testing gas meters without removing them from service.

The cut shows the testing device in position, and how meter can be tested and its correctness determined without removal, thereby making a great saving of expense to companies, who, according to custom, are continually changing meters in order to ascertain their measuring accuracy.

The tank (1) is filled to its capacity with water; (2) the thermometer, which indicates the temperature of the gas; (3) thermometer to indicate temperature of the water, which must be the same as that of the gas; opening cock (4) and closing (5) (which, when turned off, allows the gas to escape through a special opening) enables the operator to get the temperature of the gas; this being done, open 5, and the pressure under which the gas is flowing will be indicated by the rise of the water in gauge, in glass tube 6, and shown on pressure gauge 7, in 10ths of inches.

The outlet for water is 8 and 9, the cap to opening through which the tank is filled with water; 10 is conduit from tank to pressure gauge, and 11 the gas burner connection, by which the water is heated to the temperature of the gas, if this is necessary.

When a test is to be made, the inlet rubber tube is connected to a gas jet, the temperature of the water corresponding to that of the gas, and the cocks are opened to let the gas flow into the tank, the pressure being indicated in gauge (6), which, before the gas is turned on, stands at zero. The faucet is then opened and the water allowed to flow out at a rate that keeps the water in guage (6) standing at zero while gas is being measured. By this arrangement the gas flows into the tank as freely as if it were being burned, there being neither pressure nor vacuum. When the dial hand on meter shows that 1 foot of gas has passed the faucet (8), and cock (4) are closed simultaneously. By referring to water column (7); the condition of the meter registering will be indicated by the scale showing the quantity of water remaining in the tank. If the water stands at the zero mark at the end of 1 foot, it would show the meter as registering correctly; should 1 foot of gas fail to displace 1 foot of water it would indicate the meter was registering fast, or delivering a short foot. If the water remaining in the tank after registering 1 foot on the meter fall below the zero mark on gauge, it shows the per cent. the meter is slow.

Recent Patent Issues.

Prepared for the AMERICAN GAS LIGHT JOURNAL by ROYAL E. BURNHAM, solicitor of patents and counselor in patent causes, 833 Bond Building, Washington, D. C., from whom illustrations and specifications of any patent mentioned below may be obtained for 20 cents.

1,107,038. Combined Gas Burner and Water Heater. M. H. Cohen, Brooklyn, N. Y.

1,107,370. Gas Instantaneous Water Heater. J. Shepheard, Detroit, Mich., assignor of one-half to J. J. Ellis, same place.

1,107,518. Incandescent Mantle. A. Herekovitz, Chicago, Ills.

1,107,549. Gas Controlling Mechanism. G. A. Robertshaw, Pittsburgh, Pa., assignor to F. W. Robertshaw, same place.

1,107,565. Water Heater for Gas Ranges. R. G. Whitehead, Trenton, N. J.

1,107,589. Gas Heater. W. E. Clarin, Chicago, Ills., assignor of one-half to A. Nelson, Chicago, Ills.

1,107,600. Registering Meter for Gas and the Like. W. H. Fulweiler, Moylan, Pa., assignor to The United Gas Improvement Co., Philadelphia, Pa.

1,107,612. Gas Regulator. A. J. Hodge, Pasadena, Cal., assignor to Reliance Gas Regulator and Machine Co., same place.

Items of Interest
FROM VARIOUS LOCALITIES.

ON August 1st, the employees of the Cambridge (Mass.) Gas Light Company received a share in the concern's profits equal to 5 per cent. of the wages paid the past year. The aggregate amount thus disbursed is $10,500. The proportion paid to the employees equals the per cent. received by the stockholders on their holdings. This is the third year this system has been in operation and both the company and the employees are well satisfied with its working. Through the liberality and consideration shown its employees the company feels that it is also wisely caring for the interests of the stockholders, and experience shows that the system results to the manifest advantage of both. There is not a more progressive or better conducted corporation in that State than the Cambridge Gas Light Company, and never was it more successful than to-day under the presidency and general management of Albert M. Barnes.

THE Temple (Tex.) Gas Light Company has been demonstrating an incinerator in their office, and it is reported may decide to donate it to the city to be installed in the park for municipal use.

MR. C. L. CLARK has retired from the management of the Rochelle (Ills.) Gas Company after organizing and managing the business for 8 years, and will spend considerable time in travel. He will be succeeded by Mr. E. S. Davidson, of DeKalb, who has been with the DeKalb Gas Company for 7 years.

A CORRESPONDENT in Fort Madison, Ia., writes: "Another marked improvement among the business houses in the city are the offices occupied by the Fort Madison Gas Company in the 600 block on Second street. The exterior and show window present a very attractive appearance, and a great deal of attention has been drawn by the all gas kitchen which has been on display in the window.

"The interior of the office is large and roomy, the fore part of the front room being devoted to and furnished for customers and those who wish to have the gas appliances demonstrated. On the walls are various kinds of side brackets, each connected to give the best lighting effect. At one side is a porcelain basin with an instantaneous water heater, connected so that when the faucet is turned on the gas is ignited and instantly heats the water: on turning off the faucet the gas is extinguished. Many of the gas ranges have the instantaneous lighter, by which the use of matches is entirely done away with—something which all users of gas hail with delight. In the rear of the front room are the desks, with files and other things used in business concerns. To the rear of the main room is a large store room, and in the back of this are the shops. In the front of the building, and extending in front of the Empire Theatre, are six gas arcs of new design, the lighting and extinguishing controlled from the inside by a mercury valve."

"A. H. G." WRITES from Waukegan, Ill., that each year the North Shore Gas Company gives some sort of an outing. For the last two years they have adopted the picnic form and this seems to be the most popular, as everyone can join in the sports and all get better acquainted. At this year's picnic, which was on August 22nd, some unique games were played, and the results were as follows:

Baseball: Waukegan team playing against the other districts lost 5 to 3. Pretty good ball at that.

Relay race: 100 yard dash, won by Waukegan against the other offices.

Hammer-and-nail contest: For women; first prize won by Mrs. Shinabarger.

Needle threading contest: A 2 gallon jug was provided, and the contestants were to sit on the jug laid flat and keep their feet off the ground and thread a needle; won by Mrs. Roy Milleren.

Tug-o'-war: Won by North Plant against South Plant and other towns.

Pillow fight: Straddling a piece of 6-inch pipe the contestants try to knock off his opponents; contest won by the Libertyville district.

Potato race: Won by Lake Forest district.

Various other games were indulged in, including golf, croquet, quoit throwing and bridge.

Supper was served promptly at 6 o'clock to enable those who dance to get an early start.

Everybody had an enjoyable time, and the affair was a great success.

THE Iowa Gas and Electric Company of Washington has recently expended $20,000 in the improvement of its gas service, and Washington people are delighted with the service they are now getting.

UNDER charming weather conditions, the employees of the several departments of the Providence (R. I.) Gas Company held their fourth annual outing at Grant's Station. The program started promptly on the arrival of the specials at the grounds. A ball game between the office and meter shop resulted in a victory for the latter by a score of 10 to 7. After the game lunch was served, and the afternoon was devoted to field contests of various kinds. The 100-yard dash was won by Richard Gibbons; sack race, by Martin Conley; wheelbarrow race, W. R. Gibbons; fat-man's race, A. Chapleau; three-legged race, Stanton Davis and Ernest Gillett; shoe race, John Shea; shot-put, George Holland; broad jump, William Little. The closing event was a tug of-war, won by the sturdy distribution-department team President John W. Ellis and Secretary A. F. Short were the officers present, and three rousing cheers and a tiger were given by the enthusiastic gathering for President Ellis, who expressed his appreciation and asked for three cheers for the committee of the occasion and for the employees of the company. The general committee was as follows: Superintendent George E. Allyn, Walter Brown, Arthur F. Short, James Devlin and Ernest Hanke. The athletic committee were: Chairman, Leonard J. Parker; George Holland, William H. Price, George Price, Henry Barry, John McDonough and W. H. Parker.

NEW ULM, MINN., is promised gas by October 1st. The company have a fine display of appliances and fixtures in their office on Centre street, and have a competent demonstrator in charge. Work on the plant is being rushed and numerous customers are already connected to the mains.

BAY CITY, MICH., authorities are considering a new gas ordinance. Under the old rules the only requirement as to quality of gas was that it should be "good merchantable gas with an average of 18-candle power." The proposed measure provides that pressure at the consumer's opening shall not be less than 1.8 nor more than 4.5 of water pressure, and the average shall not vary more than 100 per cent. from the minimum. The company must provide portable pressure gauges and make frequent measurements and keep a record of the same on file in its office. The gas furnished shall have an average quality of not less than 580 British thermal units, and the company shall equip itself with a proper calorimeter and make frequent tests of the quality of the gas. All determinations of pressure, heat value and chemical contents shall be kept in a record, showing the dates on which they were made, and the record shall at all times be open to inspection by the council or its authorized agents. All meters and all meter testers shall be subject to inspection by the authorized agents of the council.

THE deal whereby the Hartford Gas Company was to take over the Manchester (Conn.) gas works was practically completed when the war broke out, but the inability of the company to borrow money because of the war has interfered with the proposition. It will not be surprising if the Hartford Company buys the charter and works when money is cheaper.

MR. HERMAN BURGI, Consulting Engineer to the Portland (Me.) Gas Light Company, is deeply interested in the European war, and, because of his experience, has unusual insight into conditions there. Mr. Burgi, though a native of Switzerland, has seen service as an officer in the French army and has an intimate acquaintance with the German character from personal contact with the people. He is, therefore, specially well qualified to interpret such news as is allowed to filter through the war news censors. Mr. Burgi believes that the plan of German invasion of the French territory was a deliberate one. The frontier between France and Germany proper is too well fortified for the Germans to make any headway in attempting to pass that way, and the only way that seemed feasible for getting into France was through the neutral territory of Belgium, and it was hoped that, for the sake of a guarantee of protection of Belgian neutrality, the German army would be allowed to pass through. The refusal of Belgium to consent to this plan of campaign was a temporary set back to the German plans. These elaborately worked out plans which have doubtless been awaiting the present exigencies, Mr. Burgi thinks, had as their final purpose the placing of the German army in the rear of the French forces on the frontier, cutting off communication between this army and the French capital. Their expectation was to crush the French at a single blow, and this is the plan which he believes it is Germany's purpose to fulfil. If there are no internal dissensions in Germany, if the Kaiser is able to keep his people satisfied with the conduct of the war, it seems to him that eventually the German armies will succeed. The great menace to Germany, in Mr. Burgi's opinion, lies in the danger of internal dissension, some signs of which appear in the small amount of news we have been able to obtain from Germany.

MANAGER WILLIAM H. WEST of the Westbrook (Me.) Gas Company, accompanied by his wife, is taking an automobile trip through the Middle West. They go as far as Detroit, going through Massachusetts and New York. On the return trip they will visit Pittsburgh and other places in Pennsylvania.

ONLY three bids for construction of the Virginia, Minn., municipal gas plant were received, and it is probable that other bids will be asked for. The bids received were from Risber & Marwick, Virginia, for gas mains only, $25,500; Charles C. Butler, Virginia, gas mains only $22,153.25; American Gas Construction Company, Newton, Ia., gas plant, mains and machinery, $58,000.

THE Benton Harbor-St. Joseph (Mich.) Gas and Fuel Company announces a voluntary reduction in the price of gas, effective September 1, for consumers in both cities. The result will be dollar gas for the household consumer, a reduction of 5 cents, for the present rate, deducting the discount for payment within 15 days, is $1.05 for each 1,000 feet. This rate will be effective for the first 10,000 cubic feet consumed. For the next 10,000 feet the rate will be 90 cents, and in excess of 20,000 feet will be 80 cents. The present net rate in excess of 10,000 feet is $1.

THE proposed million-dollar-by-product coke ovens to be constructed by the Durham Coal and Iron Company will be located at Allen Park, a suburb of Chattanooga, at the foot of Lookout Mountain. The site was donated by the Chattanooga Chamber of Commerce. Control of the plant will be vested in the Chattanooga Gas and Coal Products Company. The plant's daily productson will be 300 tons of foundry coke, and the gas made will be sold to the Chattanooga Gas Company. The present price of gas in Chattanooga is $1.10 a thousand, with a 10-cent discount, making what is known as dollar gas. To manufacturers the gas company makes prices ranging downward from 80 cents to 50 cents, with a 10 cent discount, depending upon the quantity guaranteed as the minimum. No intimation is made as to how much these prices will be reduced following a contract with the products company. The Chattanooga Gas and Coal Products Company is a New York corporation recently organized with a capital stock authorized of $550,000. Mr. Wolle is the president of the company.

WITH the reconstruction of the old plant of the Perth Amboy (N. J.) Gas Light Co. and the doubling of its present size, operations for which are rapidly progressing, the company promises its customers cleaner, purer and brighter burning gas.

THE Port Huron (Mich.) Gas Company proposes to change its discount method. At present a discount is allowed patrons if their accounts are paid before the 10th of each month, and it is found that the majority hold off until the last 2 or 3 days, and as a result a congestion results at the office and it is almost impossible to take care of the accounts. The plan as outlined by the company in its proposed change is to divide the city into two sections and have the accounts payable in one section from the 1st to the 10th of the month, and in the other from the 15th to the 25th. It is pointed out that this plan is in operation in other cities and has worked out successfully. The company wants the present city ordinance in connection with the payment of these accounts amended so as to place the above plan in effect.

RECENT tests of the gas supply of Indiana, made by inspectors of the Public Service Commission, shows that in all of the cities the companies supplying gas are giving a better supply than demanded by the standard fixed by the Commission. In Richmond, the supply showed 1,220 units; in Muncie, 1,280; and in Anderson, 1,183. The report shows the supply in other Indiana cities to be: Elwood, 940; Kokomo, 617; Marion, 1,170; Fort Wayne, 616; Huntington, 670; Lafayette, 634; Frankfort, 617; Lebanon, 635; Crawfordsville, 615; and Indianapolis, 645.

Utilities Commission News.

BONDS AUTHORIZED.—The Public Service Commission for the Second District, New York, has authorized the Fulton Gas and Electric Company to issue bonds to the amount of $33,000. The bonds will be 2 year gold notes drawing 6 per cent., and will be dated March 1, 1914. The proceeds will be used, together with the proceeds of a sale of $244,124 some time ago, in extension of the company's business. The company expects to spend $24,850 in new gas equipment and mains.

DIVIDE COST OF SERVICES.—Agreement, with slight modifications in some instances, was reached before the Public Utilities Commission of Washington, D. C., by representatives of local gas companies and several citizens' associations, on proposed new regulations governing the extension of gas mains and the cost for installation and maintenance of services. It was agreed by the representatives of the producers and the consumers that the cost of service pipes shall be borne equally by the property owner and the company and that the latter shall bear the expense of maintenance. It had been suggested by the Commission that the company should pay the expense of installation from main to property line and the consumer the installation within the property line, each to maintain his pipe. The change was suggested by Ben L. Minor, representing the Washington Gas Light Company.

EXAMINING SCHEDULES.—The Public Service Commission of Pennsylvania has caused the gas and electric companies of Chester County to file at the office, at Harrisburg, certified copies of the schedule of rates charged patrons, and an adjustment will be ordered where the Commission believes there are discrepancies. In one instance, the Commission has made a change in what is called a wholesale rate to large establishments. It is said that these must pay the companies the same rate for the first 1,000 feet of gas used as private citizens, after which a lower rate may be made.

DISMISSES GAS COMPLAINT.—The commission rendered a decision in the complaint brought by the city of Los Angeles against the Southern California Gas Company, the Los Angeles Gas and Electric Corporation, the Southern California Edison Company, and the Economic Gas Company. The city sought to compel the gas companies to resume the supply of natural gas to the citizens of Los Angeles. Since February 20, 1914, there has been practically no natural gas sold or used in Los Angeles except by the Los Angeles Gas and Electric Corporation and the Southern California Gas Company in their own plants, although at the hearing it developed that a large supply was available. The jurisdiction of the commission in this case was in doubt. The commission finally decided it had no jurisdiction to compel any of the companies to deliver natural gas in Los Angeles, and in so far as the complaint asked for relief in this particular, it must be dismissed.

MARYLAND RULES.—The Maryland Public Service Commission has issued a call for a conference in Baltimore on September 22 of representatives of all the gas companies operating in Maryland, with a view to establishing a uniform standard for lighting and heating. The subjects to be discussed are:

I. Accuracy of Meters—1, method of testing; 2, limit of error allowable.

II. Calorific Value—1, importance; 2, method of testing; 3, minimum value; 4, variation allowable; 5, gross or net value.

III. Candle Power—1, importance; 2, how defined; 3, how measured (a, kind of photometer; b, what standard; c, what kind of burner); 4, minimum value; 5, variation allowable.

IV. Composition—1, restriction as to impurities (a, ammonia; b, sulphur-total; c, sulphur as H_2S; d, dilutents).

V. Installation—1, safety: 2, adequacy.

VI. Pressure.

PRESENT VALUE.—The California Commission defines the term "present value" as the "reproduction cost" less the diminution in the value of the physical elements of the property, due to use, age, obsolescence, inadequacy, or other causes, this diminution being called "depreciation," and plus the increase in the value of the physical elements of the property, due to age or other causes, this increase being called "appreciation." "Present value" might be defined as "depreciated and appreciated reproduction cost," says the commission's report.

Financial Notes.

THE Ohio Cities Gas Company has issued a consolidated balance sheet of date of August 1. Current assets are shown as $941,487, of which $717,417 are in cash, with current liabilities of $156,090. Property, plant and equipment are carried at $15,568,019, comparing with a value placed on the property by the Ohio Tax Commission, exclusive of oil and gas producing properties in Ohio and West Virginia, of $8,321,990.

BROOKLYN UNION GAS COMPANY has declared the regular quarterly dividend of 1½ per cent. Three months ago a 1 per cent. extra dividend was declared in addition to the regular quarterly dividend, but the extra is declarable only semi annually and did not come up for consideration. It is scheduled to be declared at the November meeting. Dividend is payable October 1 to stock of record September 12.

THE Consolidated Gas Company, of New York, has concluded arrangements to retire $5,000,000 4 per cent. notes maturing August 25.

AMERICAN Power and Light reports those earnings of subsidiary companies.

Pacific Power and Light.
(American Power and Light Subsidiary.)

July.	1914.	1913.	Increase.
Gross	$117,606	$110,056	$6,650
Net	58,837	57,198	1,639
Bal. aft. chgs	26,936	26,025	911
Year ended July 31:			
Gross	$1,332,622	$1,265,662	$66,960
Net	693,170	505,179	97,991
Bal. aft. chgs	327,797	277,344	50,543
Div. on pfd. stock	140,000	140,000	.....
Div. on 2d pfd	105,000	95,000	10,000
Balance	82,797	42,344	40,453

*Increase.

Portland Gas and Coke.
(American Power and Light Subsidiary.)

July.	1914.	1913.	Increase.
Gross	$96,863	$93,082	$3,781
Net	49,021	44,953	4,068
Bal. aft. chgs	26,208	23,547	2,661
Year ended July 31:			
Gross	$1,288,853	$1,247,315	41,508
Net	663,406	619,316	44,242
Bal. aft. chgs	394,688	385,837	8,851
Div. on pld. stk	133,000	99,750	33,250
Balance	261,688	286,087	*24,399

*Decrease.

Kansas Gas and Electric.
(American Power and Light Subsidiary.)

July.	1914.	1913.	Increase.
Gross	$76,252	$67,990	$8,262
Net	25,980	25,156	824
Bal. aft. chgs	11,227	10,702	525
Year ended July 31:			
Gross	$1,112,605	963,082	149,523
Net	402,249	335,414	66,835
Bal. aft. chgs	224,343	166,217	58,126
Div. on pfd. stk	105,000	105,000	.....
Balance	119,343	61,217	58,126

"SOUND FINANCING" is the term used in financial circles in commenting on the offer by the Consolidated Gas, Electric Light and Power Company, of Baltimore, Md., to exchange its $5,138,654 of preferred stock for an equal amount of common stock. In so far as the common stock is paying a 7 per cent. dividend and the preferred 6 per cent., which latter rate cannot be raised, the offer was considered as desirable from the stockholders' standpoint. It is stated that those holders of preferred who exchanged about $1,500,000 for common stock six months ago have had no reason to regret their action.

The only hitch that is likely to occur in the retirement of the preferred stock comes from the fact that a good deal of this paper is tied up in trust estates, and these trustees may not feel the same freedom of action as if the stock were their own.

Financial men do not look on the fact that the 7 per cent. dividend has no guarantee as any cause for hesitation. Many of the brokers state that they will recommend the exchange without fear of injury to their customers.

THE Salt Lake Light and Traction Company of Salt Lake City has been incorporated under the laws of Utah, with a capitalization of $1,000,000. It is understood that this is the company which will be organized by D. C. Jackling and his associates to take over from the Oregon Short Line the common and preferred stocks of the Utah Light and Railways Company, which operates the street railways and electric lighting and power systems of Salt Lake City and surrounding towns and the electric light and power and gas systems of Ogden, Utah.